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ELECTRICAL WORLD AND ENGINEER.

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SINGLE-PHASE COMMUTATOR MOTORS.

Elsewhere we print the first part of an article on "Single-Phase Commutator Motors," by Mr. Seijiro Sugiyama, a Japanese electrical engineer. Mr. Sugiyama employs the symbolic method of Steinmetz for representing quantities in electrical time quadrature, and resolves the primary impressed alternating m.m.f. into two component m.m.f's of half intensity, revolving synchronously in opposite directions, in accordance with a method which Prof. Steinmetz attributes to Mr. Sugiyama. The article forms a well-prepared theoretical treatment of series and repulsion motors. The results credited to the plain series motor when compared with those shown for the other types of machines appear, however, to be unduly favorable to the former, due to the author's definition of the plain series motor, which, if it be not unjustified, is certainly very unusual. He assumes a brush displacement less than 90° from the line of polarization of the field coils. It is evident that a motor thus operated is of the forced compensated type, and the excellence of the characteristics shown for such a machine is largely due to the fact that a component of the m.m.f. of the current in the field coil compensates more or less completely for that in the armature circuit.

In discussing the repulsion motor it is stated that with increase of speed the exciting m.m.f. is shifted from the stator to the rotor coil. This statement is closely in accord with facts and is, therefore, much preferable to the one frequenty made, that leading currents are produced in the rotor, as though some condenser effect were present tending to cause the primary current to become leading. The author's conclusion obtained from his theoretical equations, that the stator current vector describes a circle passing the origin of co-ordinates, must be materially modified to conform with facts, since above synchronism the distributing influences are much more prominent than the active ones, which alone his equations consider. The fact is that the good series characteristics which the repulsion motor possesses theoretically, disappear when the machine is operated much beyond the range from zero speed to synchronism. In several respects the repulsion motor gets off well at the start, but comes in late at the finish.

RELIABILITY OF HIGH-TENSION LINES.

One of the notable differences of opinion which developed in the high-tension power transmission section of the International Electrical Congress was with respect to the immunity of very high-tension lines from lightning troubles. Mr. F. G. Baum, as the result of his experience with the great transmission system of the California Gas & Electric Company, took the somewhat radical view that it is easier to operate at 50,000 volts than at half that pressure, on the ground that since rise of voltage due to surging is approximately a linear function of the current, the higher the pressure for a given energy transmitted the less danger from abnormal rises of potential. As surging is the case of resonant phenomena most often troublesome in transmission systems, there is certainly something to be said for this point of view. But Messrs. Kelly and Bunker stated that the pressures, judged by striking distance which they had found on a 100-mile, 40,000-volt line, rose sometimes to six times the normal pressure. They regard careful adjustment of the arresters to the conditions of various parts of the system as of great importance and lay particular stress on the necessity of using rather heavy resistances with the arresters to prevent their destruction when jumped by the current. Mr. Baum, on the other hand, found ordinary types of

arresters worse than useless because provocative of too frequent discharges, and uses only large horn-type arresters with a pair of wide gaps in series which seldom worked at all. Here again there appeared to be large differences in practice due to local conditions, and most of those who joined in the discussion had suffered experiences which led them to side with Messrs. Kelly and Bunker. Certainly on lines of moderate voltage lightning is often a very serious matter, and while no lightning arresters are perfect, the best of them are unquestionably useful. Perhaps on a line well insulated for 50,000 or 60,000 volts, the factor of safety in the insulation is sufficient to take care of a large class of minor disturbances from lightning which prove very troublesome on systems less heroically insulated. In support of Mr. Baum's views might be cited the case of the Cripple Creek lines, where high-tension transmission at 26,000 volts was begun in the pioneer days, and where there is an immense amount of lightning. Here it was found that there was more trouble from lightning on the low-tension lines in the district than on the transmission lines. The radical differences of opinion that so frequently mark discussions of transmission questions appear to indicate the need of a more systematic study of the transmission problem as a whole than it has been given in the past. Practical working has brought to light small phenomena of high voltage that had been hidden from laboratory experimenters, but if these, once discovered, were submitted for determination by laboratory methods, the ultimate facts would probably be arrived at more quickly than through speculation based merely upon the casual observation of the phenomena as they occur on working lines.

REACTANCELESS RESISTANCE BOXES AT HIGH FREQUENCIES.

It is generally known that a resistance coil should be constructed of double-wound wire, or wire wound on as a loop. It is not generally known, however, that even when this precaution is taken there may be a residual inductance which at relatively high frequencies develops a considerable reactance. In the article on page 728 Dr. G. A. Campbell points out that even with wire as fine as No. 36 A. W. G., the reactance factor may be 46 per million at a frequency of one thousand cycles per second when double wound in the ordinary way. It is shown that it is possible to produce a practically reactanceless coil by double-winding the coil as usual, and then shunting the coil with a definite small condenser. The loaded resistance coil will usually have to be placed inside a static shield for use at the high frequency considered in order that capacity errors of an external nature may also be avoided.

MAGNETIC TESTING OF IRON AND STEEL.

On page 730 of this issue appears a partial report of the Committee of the American Society for Testing Materials appointed to investigate the magnetic testing of iron and steel, giving a description of a number of measurements of the $\mathfrak{H}$ $\mathfrak{B}$ relation in certain samples of cast steel. In so far as the report appears faithfully to present the observations obtained under conditions carefully defined and maintained, it deserves, in our judgment, the highest praise. The results are also valuable in showing the magnitude of the systematic errors that may be expected in such measurements, under any but the best conditions. There can be little doubt, however, that measurements of the $\mathfrak{H}$ $\mathfrak{B}$ relation in iron and steel can be conducted, in general, with a much higher degree of accuracy than a first glance at the results presented might lead one to imagine. The ring samples of cast steel tested are described as being cut from a stout disc casting. There is no mention of annealing of the rings after this cutting. The cutting tool, in such an operation, hardens the material to a certain small depth below the exposed surface and thereby locally increases its reluctivity. When, as in this case, the ring has only a relatively small cross section (in the data given it is in the neighborhood of two square centimeters), the average reluctivity may be quite appreciably increased. If, on the other hand, annealing is attempted, variable results are likely to follow, unless a standard annealing method and manipulation is followed. For this reason it is preferable to employ a relatively large cross section in the ring, say not less than twelve square centimeters, and preferably twenty. In that case annealing no longer becomes necessary, and the sample under test approximates more closely in physical condition to a mass of the same metal in a dynamo structure.

Moreover, as suggested in the report, the use of rings is open to marked error when their diameter is not many times their radial thickness. In the case of the smallest ring described (No. 10), the magnetic force in gilberts per centimeter would always be about 15 per cent. less at the outside, and greater at the inside, than along the mean circumferential path; and where the $\mathfrak{H}$ $\mathfrak{B}$ curve is not nearly straight, the average gausses as computed will differ appreciably from the maximum and minimum, or from their arithmetical mean. Only a ring of relatively large diameter should, therefore, be accepted in standard measurements of this nature. Again, the galvanometer employed must be really ballistic, and have only a small damping factor, electromagnetic or mechanical. In the data, which are excellently presented in many other details, the logarithmic decrement of the galvanometer swings is not given. It is open to suspicion as being unduly large for this class of work. The variation in damping due to change of resistance in the secondary circuit was shockingly large, as fully explained in the report. D'Arsonval galvanometers are not nearly so reliable for ballistic measurements as galvanometers with swinging magnets, although the latter often give much trouble to operate in the neighborhood of trolley systems or dynamos.

Finally, the method of calibration referred to as the "calibrating ring," upon the winding of a non-magnetic core with counterpart dimensions, is open to serious error owing to the imperfection in the primary winding considered as an indefinitely thin current sheet. On a small core, the flux within the primary winding may be much greater than that computed by the formula, on the basis of core dimensions, thereby making the gausses in the corresponding steel core appear much too small. The error is bad enough in the case of the ordinary long, straight calibrating coil. Thus, in the case of ring No. 40—the largest ring—the maximum computed density was 19 kilogausses at 100 gilberts per centimeter, corresponding to a reluctivity of 0.00526, when operated with the calibrating coil; but the corresponding maximum density was only 16⅔ kilogausses when operated with the calibrating ring, corresponding to a reluctivity of 0.006. The discrepancy here is 14 per cent. of the smaller reluctivity. It is known that, at least to a close approximation, the reluctivity of any sample of iron or steel follows a straight line law in relation to the magnetizing force, $\mathfrak{H}$. That is to say, the reluctivity may be expressed as $(a + b\,\mathfrak{H})$ where a and b are constants for the sample of iron or steel considered. For ring No. 40 the results shown in curve No. 1 of Fig. 5 give $a = 34 \times 10^{-5}$ and $b = 4.84 \times 10^{-5}$, with a satisfactory degree of approximation throughout the curve. It is of much more practical interest to plot the straight lines of reluctivity with respect to $\mathfrak{H}$, the magnetizing force, than to draw the curves of gaussage. In fact, the mere statement of the values of a and b gives the gist of the matter to an engineer as completely, and much more compactly, than the entire meandering $\mathfrak{H}$ $\mathfrak{B}$ curve.

It would seem that tests of the magnetic behavior of iron may be divided into two classes, namely, first those for accurate and

scientific purposes or physical tests, and second, those for practical purposes or engineering tests. The latter should be at least comparative, but do not need to possess the same degree of accuracy as the former. They should only call for bars as test pieces, which are more quickly and cheaply produced than rings. Tests on bars can be made expeditiously in machines for the purpose. The former class of tests for scientific purposes should only be made in laboratories on large ring samples, with the best type of ballistic galvanometers. It is our firm belief that such measurements have been, and may be, made to a far higher degree of accuracy than the .36 per cent. limit contained in the report. At the same time it must be admitted that the report is valuable as showing how readily a 36 per cent. range of discrepancy may be reached in such measurements.

Raising the Efficiency of the Arc.

At the recent convention of the Edison Illuminating Companies were read several important papers and among them one which stands conspicuous as a protest against some vicious tendencies in methods of lighting, and as the first step toward a reform in practice that has been all too slow in coming in this country. The paper in question was by Mr. G. N. Eastman and the topic considered was the changes in energy and current density upon the efficiency of the electric arc. It has long been known with respect to the open arc that high current density in the arc results in a very considerable increase of luminous efficiency. Everyone will remember the great effectiveness of the now generally discarded 9.6 amp. open arc when it could be coaxed into burning steadily, and the relative inefficiency of the 6-amp. arc. When experimentally the current density is pushed higher than it was in the old 9.6-amp. lamp the efficiency went on increasing until a figure barely above half a watt per mean spherical candle-power was reached. This figure is so greatly in excess of that generally reached with arc lights that one is almost staggered at the energy wasted in arcs of the standard type. As is well known, however, the difficulty in working with great current density lay in the unpleasant alternative presented between using a large current and thus concentrating a very large amount of light in a single unit, and using smaller carbons with their great inconvenience in the matter of extra care. Carbon consumption was bad enough in the open arc as used without aggravating the difficulty by forcing the output. Commercial requirements were clearly against a higher efficiency gained at the expense of a serious increase in labor and material. It is the case of the incandescent lamp over again—it does not pay to work above a certain point of efficiency, and the higher the cost of labor and supplies, the greater the handicap placed upon high efficiency.

So it came to pass that when the enclosed arc was introduced it at once pushed the open arc to the wall in American practice. Abroad where a very different relation prevails between the cost of labor and carbons and the cost of energy the enclosed arc has made practically no headway. How low the luminous efficiency of the enclosed arc really is few even among the electric lighting men fully realize. For outdoor use where the superior distribution from the enclosed arc counts heavily in its favor the disadvantage was but little felt, and so long as the lamps used were of 6 or 7 amp. the loss of efficiency could not be considered very serious. But when a demand arose for further subdivision of the arc and in response to it lamps taking 3.5 to 5 amp. became fairly common, the lowered efficiency was rather severely felt, particularly since the color of these little arcs was far less satisfactory than that of those first introduced. Working off a 120-volt constant potential circuit and reckoning as one must commercially the energy of the terminals of the lamp, Mr. Eastman's figures show for a 5-amp. arc about 2.5 watts per mean spherical candle-power, and for a 3.5-amp. arc about 3.4 watts per candle-power. These figures are in close accord with those obtained by other experimenters and show plainly enough that the process of saving care and carbons at the expense of efficiency has been rather overdone.

Mr. Eastman's experiments had for an object to secure data for the remedy of this evident defect. He attacked the problem along two lines, first increase of the energy in the arc by raising the voltage utilized, with current and carbons remaining the same; and second by using carbons of smaller diameter and thus raising the current density while leaving the energy constant. As might have been anticipated the former procedure resulted in a long blue arc of a rather unstable character, but still gave a considerable increase in candle-power with a slight increase in efficiency. By raising the voltage of a 3.5-amp. arc from 80 to 120 volts the energy was increased 50 per cent., the candle-power was increased 77 per cent. and the watts per candle were decreased about 15 per cent. Even this small increase in efficiency should probably be charged to casual causes. The carbons used were the ordinary ½-in. description ordinarily used in such lamps. Raising the current density, however, proved to be highly efficacious. On the 3.5-amp. lamp using 420 watts at the terminals a change from ½-in. to 5/16-in. carbons raised the mean spherical candle-power from 123 to 188 and lowered the terminal watts per candle from 3.41 to 2.23. With a 5-amp. lamp the results were naturally even better. The candle-power rose from 238 to 330 and the watts per candle dropped from 2.52 to 1.82. The arc from the 5/16-in. carbon was far whiter and more stable than with the larger carbons and the life of the carbons was still reasonably long, reaching about 64 hours. Further tests were made on a 3.5-amp. lamp with 3/16-in. carbons against ½-in. carbons showed that the candle-power with the former was practically doubled for the same expenditure of energy, although a pencil so small as 3/16 in. necessarily gives a rather short life.

While the above efficiencies are far lower than obtained from the open arc under similar conditions of current density, they show the feasibility of very considerably improving the efficiency of the enclosed arc while still retaining to a considerable degree its fundamental advantage of long hours of burning. Incidentally, Mr. Eastman notes that the smaller carbons with their lessened life naturally cloud the inner globe much less than the larger carbons allowed to burn their full life, so that the very considerable loss of light due to the dirt on the inner globe would be greatly reduced by the substitution. The improvement in the quality of the light is an even more important advantage of raising the current density, although hard to estimate on any commercial basis. But the improved steadiness of the intensified arc and above all its comparative freedom from the unpleasant blue shade now generally found should count heavily for it in public appreciation. Surely after experiments so conclusive as these a general adoption of the small carbons ought to follow. The means of relief is so simple that the wonder is that it had not been practiced before. No illuminant with a really strong color of any kind meets the general requirements of illumination, and bad color has been the conspicuously weak point of the enclosed arc with small current. That it has been taken as good naturedly as it has been is a wonder. The improvement which can be made by a change in the size of carbons is altogether startling and once the operating companies begin to make the change it will go rapidly. Think of the sensation, too, that would follow the introduction of a new incandescent lamp working at 2½ watts per candle instead of 3.4 watts. Yet this reduction is just what the small carbon does for the 3.5-amp. arc. The world is waiting for something new and strange in the way of illuminants, but if it would get to work and use those that it has intelligently, the weary years of hopes deferred would be more cheerful ones.

Awards in Department of Machinery at St. Louis Exposition.

Following is an unofficial list of awards in the Department of Machinery of the St. Louis World's Fair. Some additions to the list, and some changes in it, may be made prior to official promulgation.

The lists of awards in the Department of Electricity and in the Department of Transportation have not yet been completed:

GRAND PRIZES.

United States:

Alberger Condenser Co., New York City.
Allis-Chalmers Co., Chicago, Ill.
American Meter Co., New York City.
Ashcroft Mfg. Co., New York City.
The Aultman & Taylor Machinery Co., Mansfield, Ohio.
E. W. Bliss Co., Brooklyn, N. Y.
Brown Hoisting Machinery Co., Cleveland, Ohio.
Brown & Sharpe Mfg. Co., Providence, R. I.
Coe Mfg. Co., Painesville, Ohio.
Continental Iron Works, Brooklyn, N. Y.
Crosby Steam Gauge & Valve Co., Boston, Mass.
Abner Doble Co., San Francisco, Cal.
Estate of W. S. Doig, Brooklyn, N. Y.
General Electric Co., Schenectady, N. Y.
Gisholt Machine Co., Madison, Wis.
Goldschmidt Thermit Co., New York City.
R. Hoe & Co., New York City.
E. & B. Holmes Machinery Co., Buffalo, N. Y.
Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio.
A. Leschen & Sons Rope Co., St. Louis, Mo.
Lidgerwood Mfg. Co., New York City.
Niles-Bement-Pond Co., New York City.
Norton Grinding Co., Worcester, Mass.
Otis Elevator Co., New York City.
Pawling & Harnischfeger, Milwaukee, Wis.
Pratt & Whitney Works, Hartford, Conn.
Robins Conveying Belt Co., New York City.
The Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Wm. Sellers Co., Inc., Philadelphia, Pa.
The Shaw Electric Crane Co., Muskegon, Mich.
Sloan & Chace Mfg. Co., Newark, N. J.
The Warner & Swasey Co., Cleveland, Ohio.
Westinghouse Machine Co., Pittsburg, Pa.
R. D. Wood & Co., Philadelphia, Pa.
Henry R. Worthington, New York City.

France:

Association Francaise de Proprietaires D'appareils a Vapeur, Paris.
Compagnie pour la Fabrication des Compteurs & Materiel d'usines a Gaz, Paris.
Frederic Fouche, Paris.
Savy, Jeanjean & Co., Paris.

Germany:

Elsaessische Maschinenbau-Gesellschaft, Muelhausen.
Orivit Works, Coeln.
Schaeffer & Budenberg, G.m.b.H. Magdeburg-Buckau.

Great Britain:

Davidson & Co., Ltd., Belfast, Ireland.
John Fowler & Co. (Leeds), Ltd., Leeds, England.

GOLD MEDALS.

United States:

Acme Machinery Co., Cleveland, Ohio.
The Alvey-Ferguson Co., Louisville, Ky.
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Armstrong Bros. Tool Co., Chicago, Ill.
Ashton Valve Co., Boston, Mass.
Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Betts Machine Co., Wilmington, Del.
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Black Bros. Mfg. Co., Mendota, Ill.
E. W. Bliss Co., Brooklyn, N. Y.
Wm. T. Bonner Co., Boston, Mass.
Hugo Bilgram, Philadelphia, Pa.
Buckeye Engine Co., Salem, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Builders' Iron Foundry, Providence, R. I.
A. S. Cameron Steam Pump Co., New York City.
The Carborundum Co., Niagara Falls, N. Y.
The Philip Carey Mfg. Co., Lockland, Ohio.
Chicago Pneumatic Tool Co., Chicago, Ill.
Cleveland Automatic Machine Co., Cleveland, Ohio.
The Consolidated Safety Valve Co., New York City.
Crane Co., Chicago, Ill.
Dearborn Drug & Chemical Works, St. Louis, Mo.
DeLaval Steam Turbine Co., New York City.
Dodge Mfg. Co., Mishawaka, Ind.
Eureka Fire Hose Co., Jersey City, N. J.
E. & T. Fairbanks & Co., St. Johnsbury, Vt.
Fairbanks, Morse & Co., Chicago, Ill.
Ferracute Machine Co., Bridgeton, N. J.
The Fisher Governor Co., Marshalltown, Iowa.
Geiser Mfg. Co., Waynesboro, Pa.
The Goulds Mfg. Co., Seneca Falls, N. Y.
Green Engineering Co., Chicago, Ill.
The Hancock Inspirator Co., New York City.
Harrisburg Foundry & Machine Works, Harrisburg, Pa.
Harrison Safety Boiler Works, Philadelphia, Pa.
Hayden & Derby Mfg. Co., New York City.
Hall & Brown Wood Working Machine Co., St. Louis, Mo.
Heine Safety Boiler Co., St. Louis, Mo.
Hendey Machine Co., Torrington, Conn.
Hercules Gas Engine Works, Inc., San Francisco, Cal.
The Hooven, Owens, Rentschler Co., Hamilton, Ohio.
C. W. Hunt Co., New York City.
Jones & Lamson Machine Co., Springfield, Vt.
Kieley & Mueller, New York City.
Lagonda Mfg. Co., Springfield, Ohio.
Landis Tool Co., Waynesboro, Pa.
The Lombard Governor Co., Boston, Mass.
The Long & Allstatter Co., Hamilton, Ohio.
The Lunkenheimer Co., Cincinnati, Ohio.
Medart Patent Pulley Co., St. Louis, Mo.
August Meitz, New York City.
The National Acme Mfg. Co., Cleveland, Ohio.
National Meter Co., New York City.
National Supply Co., Chicago, Ill.
Norton Emery Wheel Co., Worcester, Mass.
The Otto Gas Engine Works, Philadelphia, Pa.
Pittsburg Meter Co., Pittsburg, Pa.
Pratt & Whitney Works, Hartford, Conn.
Prentice Bros. Co., Worcester, Mass.
Putnam Machine Co., Fitchburg, Mass.
F. E. Reed Co., Worcester, Mass.
Richardson Scale Co., New York City.
Rider-Ericsson Engine Co., New York City.
Wm. Sellers Co., Inc., Philadelphia, Pa.
Shultz Belting Co., St. Louis, Mo.
H. B. Smith Machine Co., Smithville, N. J.
L. S. Starrett Co., Athol, Mass.
The Stillwell-Bierce & Smith-Vaile Co., Dayton, Ohio.
Voorhees Rubber Mfg. Co., Jersey City, N. J.
Walworth Mfg. Co., Boston, Mass.
Weber Gas & Gasoline Engine Co., Kansas City, Mo.
J. H. Williams & Co., Brooklyn, N. Y.
Williams, White & Co., Moline, Ill.
Yale & Towne Mfg. Co., New York City.

Belgium:

Association des Industriels de Belgique Pour L'Etude et la Propaganda des Engins et des Mesures Propres A Preserver Les Ouvriers des Accidents du Travail, Brussels.
Vertongen-Goens Co., Ltd., Termonde.

France:

A. Domage & Fils, Paris.
Prof. Ribourt, Le Besvinet.
Charles Sebin, Paris.
Societe DeLaval, Paris.

Germany:

H. Bieling, Iseglitz-Berlin.
Friedrich Dick, Esslingen a. Neckar.
Dryer, Rosenkranz & Droop, Hanover.
Dusseldorf-Ratinger Rohrenkesselfabrik, Ratingen.
C. Otto Gehrckens, Hamburg.
Friedrich Goetze, Burscheid bei Coeln a. Rh.
Friedrich Lux, Ludwigshafen a. Rh.

Japan:

Shibaura Works of Mitsui & Co., Tokio.

Mexico:

Fabrica Nacional de Armas, Mexico, Jeronimo Elizondo, Monterey, Nuevo Leon.

Wireless Telegraph Legislation in Great Britain.

We give below the chief points in the British Wireless Telegraph Act, 1904, restricting and controlling wireless telegraphy:

It is prohibited to establish any wireless telegraph station, or install or work any apparatus for wireless telegraphy, in any place or on board any British ship except under and in accordance with a licence granted by the Postmaster-General.

Any person who establishes a wireless telegraph station without a licence, or installs or works any apparatus for wireless telegraphy without a licence, shall be guilty of a misdemeanor, and be liable to a penalty not exceeding £10, and on conviction on indictment to a fine not exceeding £100, or to imprisonment, with or without hard labor, for a term not exceeding 12 months, and in either case be liable to forfeit any apparatus for wireless telegraphy installed or working without a licence. No proceedings, however, can be taken against any person except by order of the Postmaster-General, the Admiralty, the Army Council or the Board of Trade. It is further provided that if a justice of the peace is satisfied by information on oath that there is reasonable ground for supposing that a wireless telegraph station has been established without a licence, or that any apparatus for wireless telegraphy has been installed or worked in any place or on board any ship within his jurisdiction without a licence, he may grant a search warrant to enter and inspect the station, place or ship, and to seize any apparatus which appears to him to be used, or intended to be used, for wireless telegraphy therein.

The expression "wireless telegraphy" is defined to mean any system of communication by telegraph without the aid of any wire connecting the points from and at which the messages or communications are sent and received. It is provided, however, that nothing in the act shall prevent any person from making or using electrical apparatus for actuating machinery or for any purpose other than the transmission of messages.

Where the applicant for a licence proves to the satisfaction of the Postmaster-General that the sole object of obtaining the licence is to enable him to conduct experiments in wireless telegraphy, a licence for that purpose shall be granted, subject to such special terms, conditions and restrictions as the Postmaster-General may think proper, but not be subject to any rent or royalty. Where an applicant for a licence satisfies the Postmaster-General that a wireless telegraph station is to be used solely for the transmission of telegrams which are within the first or second exception from the exclusive privilege of transmitting telegrams conferred upon the Postmaster-General by the Telegraph Act, 1869, a licence for that purpose, if granted, shall not be subject to any rent or royalty.

It shall be lawful for the Postmaster-General, due regard being had to the maintenance and exercise of effective control over wireless telegraphy, to grant special licences at reduced terms for the establishment and working of wireless telegraph stations to be used exclusively for the transmission within the United Kingdom of news to public registered newspapers.

The act extends to the whole of the British Islands and to all British ships in the territorial waters abutting on the coast of the British Islands, and may be made to extend, subject to any conditions, exceptions and qualifications contained in the order, to apply to British ships whilst on the high seas.

It is further provided that no foreign ship shall work wireless apparatus in British waters except in accordance with regulations prescribed by the Postmaster-General.

Underground Rapid Transit in New York City.—II.

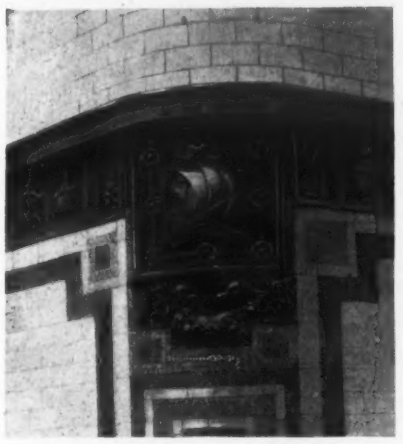


FIG. 1.—DECORATION AT COLUMBUS CIRCLE STATION.

IN the preceding article a description was given of the general conditions that pertain to the underground system of the Interborough Rapid Transit Company of New York City, and of the power house and its main generating plant. It will be remembered that among the principal features were the use of reciprocating engines and vertical alternators of the stationary armature revolving field type, supplying current at 11,000 volts, 25 cycles, with transformation and conversion to direct current for the track and motors at 625 volts. Views were also shown in the article of the main switchboard and oil switch apparatus, with a diagram of the circuits in the main power house. The switch used for the 11,000-volt circuits is so constructed that the circuits are made and broken under oil, the switch being electrically operated. Two complete and independent sets of bus-bars are used, and the connections are such that each alternator and each feeder may be connected to either of these sets of bus-bars at the will of the operator. From alternators to bus-bars the current passes, first, through the alternator switch, and then alternatively through one of the other of two selector switches which are connected, respectively, to the two sets of bus-bars.

THE DISTRIBUTION OF CURRENT.

The next important element in the distributing system of current supply is the sub-station. Provision is made for an ultimate total of twelve sub-stations, to each of which as many as eight feeders may be installed if the development if the company's business should require that number. Eight sub-stations are required at present, and to some of these not more than three feeders each are necessary.

The aggregate number of conductors installed for the feeders are arranged in groups, each group being supplied from a set of auxiliary

FIG. 2.—OPERATING SWITCHBOARD IN GALLERY OF SUB-STATION NO. 11.

bus-bars, which in turn receives its supply from one or the other of the two sets of main bus-bars; means for selection being provided, as in the case of the alternator circuits, by a pair of selector switches, in this case designated as group switches. Any and every switch can be opened or closed at will by the operator standing at the control board described. The alternator switches are provided also with automatic overload and reversed-current relays, and the feeder switches, as above mentioned, are provided with automatic overload relays. These overload relays have a time attachment which can be set to open the switch at the expiration of a predetermined time ranging from .3 of a second to 5 seconds. The type H oil switch is operated by an electric motor through the intervention of a mechanism comprising powerful springs which open and close the switch with great speed. This switch when opened introduces in each of the three sides of the circuit two breaks which are in series with each other. Each side of the circuit is separated from the others by its location in an enclosed compartment with enclosing walls of brick and soapstone. The control board, shown last week, is of the excellent Stillwell type, already familiar to our readers; and the instrument board was also shown. All this apparatus is of General Electric manufacture.

CABLES AND CONDUITS.

From alternators to alternator switches the 11,000-volt, alternating

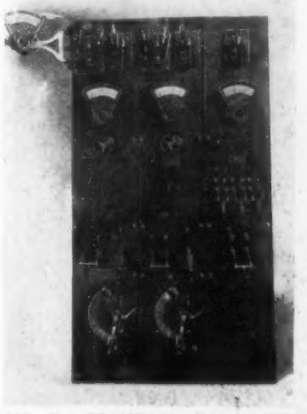


FIG. 3.—STANDARD SUB-STATION BOARD FOR MOTOR-GENERATORS AND BATTERIES.

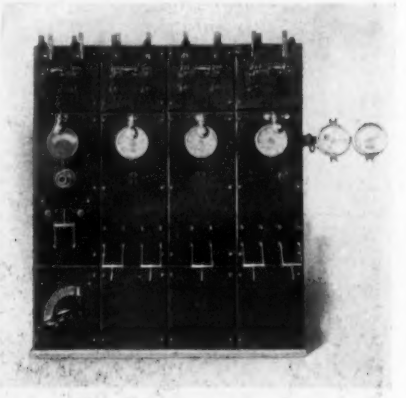


FIG. 4.—SUB-STATION SWITCHBOARD FOR BLOCK SIGNAL PLANT.

currents are conveyed through single conductor cables, insulated by oil cambric, the thickness of the wall being 12/32 of an inch. These conductors are installed in vitrified clay ducts. From dynamo

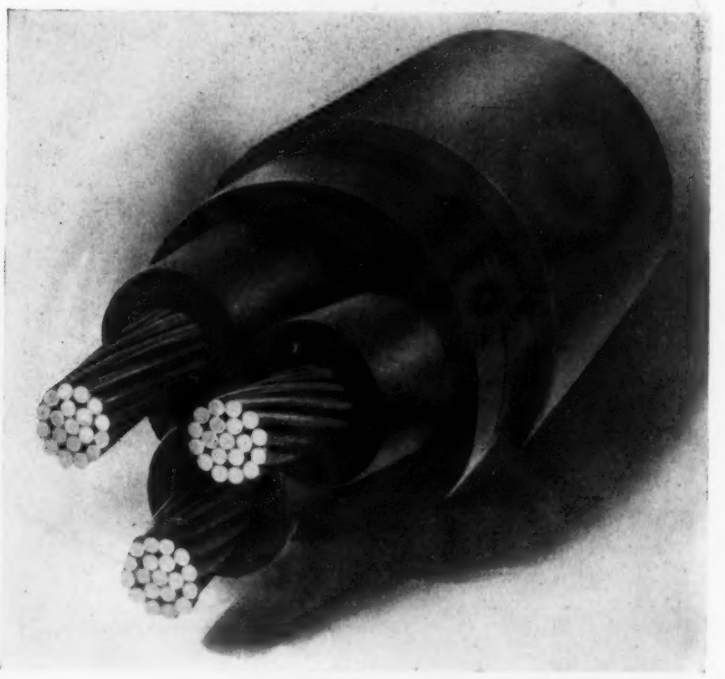


FIG. 5.—THREE-CONDUCTOR NO. 000 CABLE FOR 11,000-VOLT DISTRIBUTION.

switches to bus-bars and from bus-bars to group and feeder switches, vulcanized rubber insulation containing 30 per cent. pure Para rubber is employed. The thickness of insulating wall is 9/32 of an inch and the conductors are supported upon porcelain insulators. From the power house on the Hudson River to the Subway at Fifty-eighth Street and Broadway two lines of conduit, each comprising thirty-two ducts, have been constructed by the company. These conduits are located on opposite sides of the street, whence they extend to

the sub-stations and track network. From City Hall to Ninety-sixth Street (except through the Park Avenue Tunnel) sixty-four ducts are provided on each side of the Subway. North of Ninety-sixth Street sixty-four ducts are provided for the west side lines and an equal number for the east side lines. Between passenger stations these ducts help to form the side walls of the Subway, and are arranged thirty-two ducts high and two ducts wide. Beneath the platform of passenger stations the arrangement is somewhat varied because of local conditions. In order to minimize the risk of interruption of service due to possible damage to a considerable number of cables in one of the manholes at the ends of the station platforms, resulting from short-circuit in a single cable, all cables except at the joints are covered with two layers of asbestos aggregating a full ¼ inch in thickness. This asbestos is specially prepared and is applied by wrapping the cable with two strips each 3 inches in width, the outer strip covering the line of junction between adjacent spirals of the inner strip, the whole when in place being impregnated with a solution of silicate of soda. The joints themselves are covered with two layers of asbestos held in place by steel tape applied spirally.

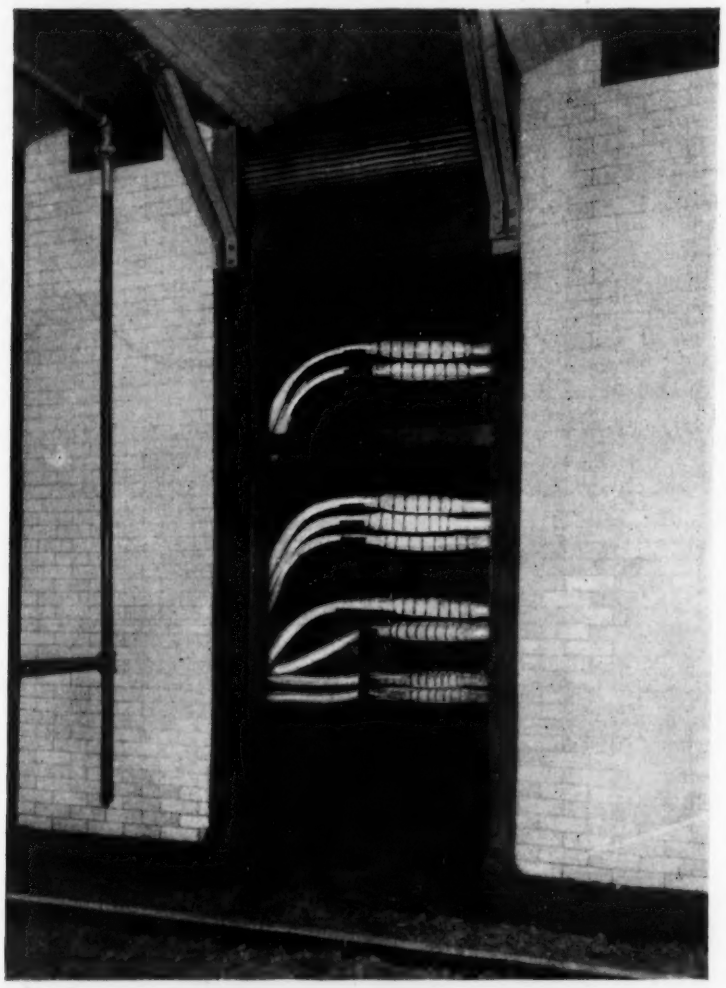


FIG. 6.—CABLE MANHOLE IN SUBWAY WITH ROLLING SHUTTER DOOR.

To distribute the strains upon the cables in manholes, radial supports of various curvatures, and made of malleable cast iron, are used.

To diminish further the risk of interruption of the service due to failure of power supply, each sub-station south of Ninety-sixth Street receives its alternating current from the power house through cables carried on opposite sides of the Subway. To protect the lead sheaths of the cables against damage by electrolysis, rubber insulating pieces 1/16 of an inch in thickness are placed between the sheaths and the iron bracket supports in the manholes.

The cable used for conveying current from the power house to the several sub-stations aggregates approximately 150 miles in length. It comprises three-stranded copper conductors each of which contains nineteen wires, and the diameter of the stranded conductor thus formed is 3/8 of an inch. Paper insulation is employed and the triple cable is enclosed in a lead sheath 9/64 of an inch thick. Each conductor is separated from its neighbors and from the lead sheath by insulation of treated paper 7/16 of an inch in thickness. The outside diameter of the cables is 2⅝ inches, and the weight 8½ pounds per linear foot. The cable as manufactured was cut into lengths corresponding to the distance between manholes, and each length subjected to severe tests, including application to the insulation of an alternating current potential of 30,000 volts for a period of thirty minutes. These cables were installed under the supervision of the Interborough Company's engineers, and after jointing, each complete cable from power house to sub-station was tested by applying an alternating potential of 30,000 volts for thirty minutes between each conductor and its neighbors, and between each conductor and the lead sheath. These and other cables were made by the India Rubber & Gutta Percha Insulating Company, the National Conduit &

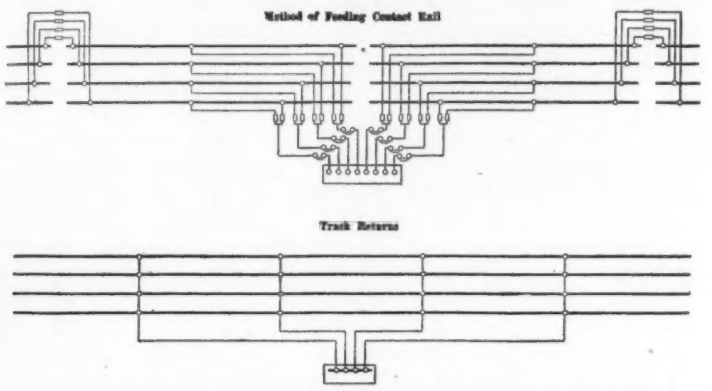


FIG. 7.—DIAGRAMS OF DIRECT-CURRENT AND RETURN CIRCUITS.

Cable Company, the Okonite Company, the Standard Underground Cable Company and the John A. Roebling's Sons Company.

THE SUB-STATIONS.

As already noted, the current generated at the power house is conveyed through the high-potential cable system to eight sub-stations containing the necessary transforming and converting machinery. These sub-stations are located as follows: City Hall Place, East Nineteenth Street, West Fifty-third Street, West Ninety-sixth Street, West One Hundred and Forty-third Street, West One Hundred and Thirty-second Street, Hillside Avenue west of Eleventh Avenue, and Fox Street, near Westchester Avenue, these all being strategetical points for an economical distribution of current.

The converter unit selected to receive the alternating current and deliver direct current to the track, etc., has an output of 1,500 kw, with ability to carry 50 per cent. overload for three hours. The

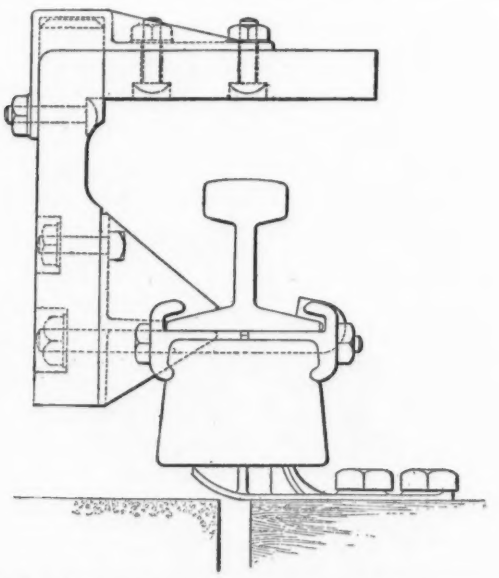


FIG. 8.—ASSEMBLY OF CONTACT RAIL AND PROTECTION.

average area of a New York city lot is 25 x 100 ft., and a sub-station site comprises two adjacent lots of this approximate size, permitting the installation of a maximum of eight 1,500-kw converters with necessary transformers, switchboard and other auxiliary apparatus. In designing the sub-stations a type of building with a central air well was selected. The typical organization of apparatus is illustrated in the views herewith and includes two lines of converters, the three transformers which supply each converter being located between it and the adjacent side wall. The switchboard is located at the rear of the station. The central shaft affords excellent light

and ventilation for the operating room. The steel work of the sub-stations is designed with a view to the addition of two storage bat-

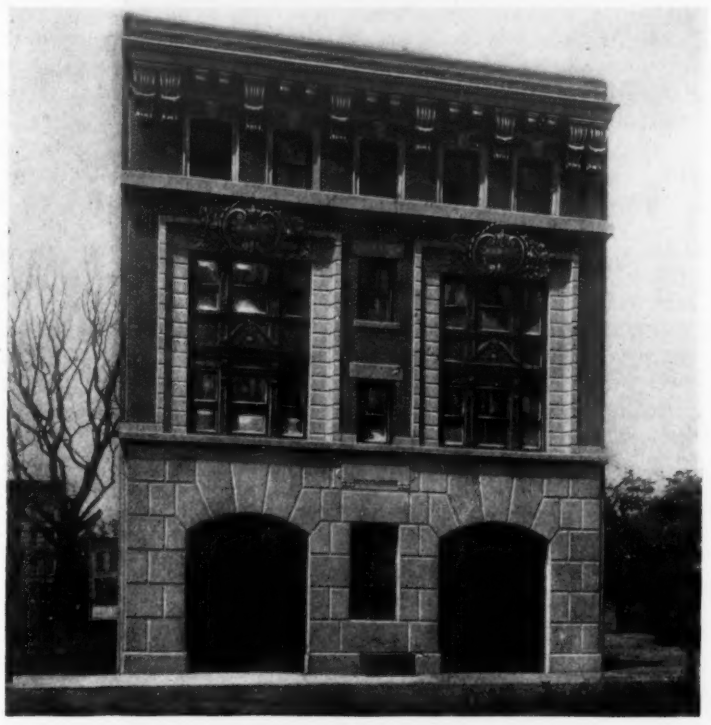


FIG. 9.—EXTERIOR OF SUB-STATION NO. 18.

tery floors, should it be decided at some future time that the addition of such an auxiliary is advisable.

The necessary equipment of the sub-stations implies sites approximately 50 x 100 ft. in dimensions, and four are practically all this size. Two are 100 ft. in length, but the lots acquired in these instances being of unusual width, these sub-stations are approximately 60 ft. wide. One, on account of wide limited ground space, is but 48 ft. wide and 92 ft. long. In each of the sub-stations, except one foundations are provided for eight converters. Sub-station No. 13 contains foundations for the ultimate installation of ten converters.

In the sub-stations, as in the power house, the high-potential, alternating-current circuits are opened and closed by oil switches, which are electrically operated by motors, these in turn being controlled by 110-volt, direct-current circuits. Diagrammatic bench

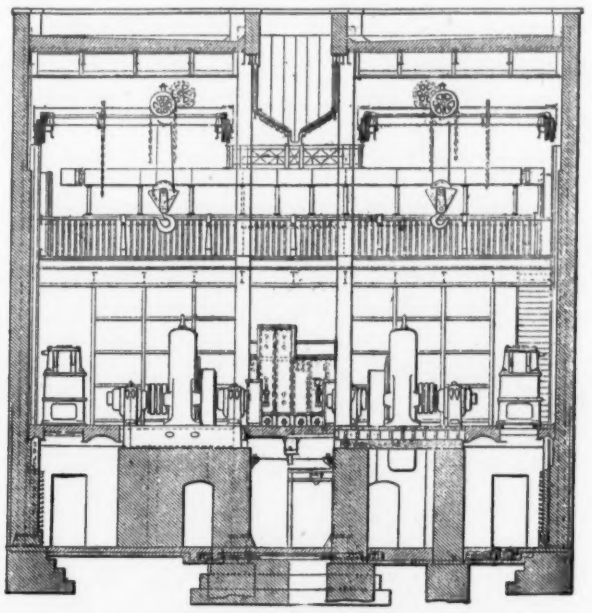


FIG. 11.—CROSS-SECTION OF SUB-STATION NO. 14.

boards are used, as at the power house, but in the sub-stations they are of course relatively small and free from complication.

The instrument board is supported by iron columns and is carried at a sufficient height above the bench board to enable the operator, while facing the bench board and the instruments, to look out over the floor of the sub-station without turning his head. The switches of the direct-current circuits are hand-operated and are located upon boards at the right and left of the control board.

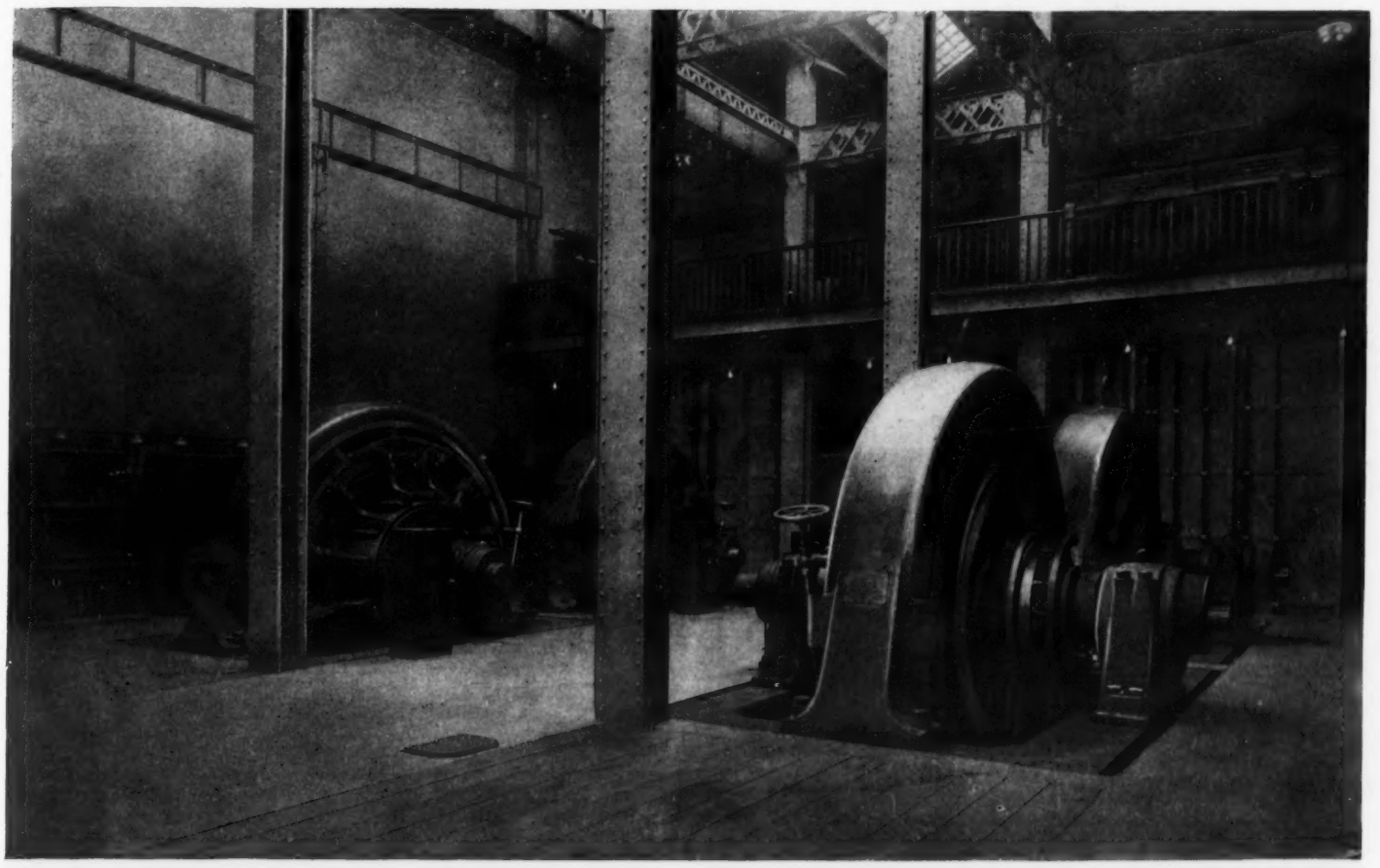


FIG. 10.—INTERIOR OF SUB-STATION NO. 11.

A novel and important feature introduced is the location in separate brick compartments of the automatic circuit-breakers in the direct-current feeder circuits. These circuit-breaker compartments are in a line facing the boards which carry the direct feeder switches, each circuit-breaker being located in a compartment directly opposite the panel which carries the switch belonging to the corresponding circuit. This plan will effectually prevent damage to other parts of the switchboard equipment when circuit-breakers open automatically under conditions of short-circuit. It also tends to eliminate risk to the operator, and, therefore, to increase his confidence and accuracy in manipulating the hand-operated switches.

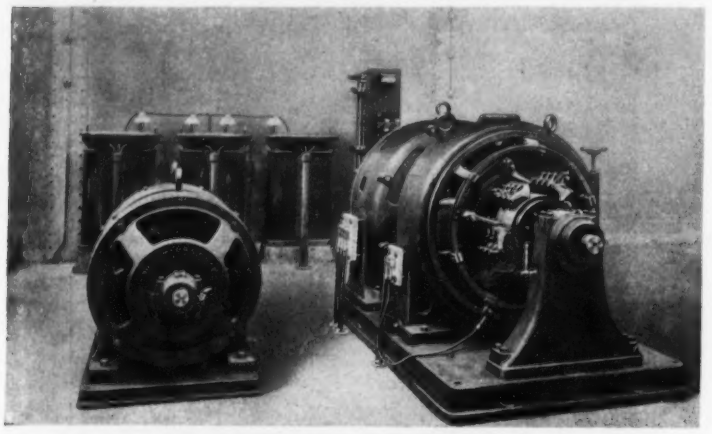


FIG. 12.—MOTOR-GENERATOR STARTING SET, TRANSFORMERS AND SWITCHBOARD.

The three conductor cables which convey three-phase currents from the power house are carried through tile ducts from the manholes located in the street directly in front of each sub-station to the back of the station, where the end of the cable is connected directly beneath its oil switch. The three conductors, thus well separated, extend vertically to the fixed terminals of the switch. In each sub-station but one set of high-potential alternating current bus-bars is installed and between each incoming cable and these bars is connected an oil switch. In like manner, between each converter unit and the bus-bars an oil switch is connected into the high-potential circuit. The bus-bars are so arranged that they may be divided into any number of sections not exceeding the number of converter units, by means of movable links, which, in their normal condition, constitute a part of the bus-bars.

FIG. 13.—TWO GROUPS OF SUB-STATION STEP-DOWN TRANSFORMERS.

Each of the oil switches between incoming circuits and bus-bars is arranged for automatic operation and is equipped with a reversed-current relay, which, in the case of a short-circuit in its alternating-current feeder cable, opens the switch and so disconnects the cable from the sub-station without interference with the operation of the other cables or the converting machinery.

The organization of electrical conductors provided to convey direct current from the sub-stations to the moving trains can be described most conveniently by beginning with the contact, or so-called third rail. South of Ninety-sixth Street the average distance between sub-stations approximates 12,000 ft., and north of Ninety-sixth Street the average distance is about 15,000 ft. Each track, of course, is provided with a contact rail. There are four tracks and consequently four contact rails from City Hall to Ninety-sixth Street, three from Ninety-sixth Street to One Hundred and Forty-fifth Street on the west side, two from One Hundred and Forty-fifth Street to Dyckman Street, and three from Dyckman Street to the northern terminal of the west side extension of the system. From Ninety-sixth Street the east side has two tracks and two contact rails to Mott Avenue, and from that point to the terminal at One Hundred and Eighty-second Street three tracks and three contact rails. To these contact rails each sub-station supplies naturally the portion within its proper and economic area.

Submarine Navigation

The problem of submarine navigation is a fascinating one and has engaged the earnest thought of inventors for many years. Apart from its use as an engine of war, the availability of the submarine boat in the pursuits of peace offer some very attractive possibilities. Mr. J. P. Holland delivered a lecture on "The Submarine Boat" before the faculty, alumni and students of Manhattan College, in Carnegie Lyceum, New York, last April, which lecture is published in the current number of *The Manhattan Quarterly*. Mr. Holland is best known as the inventor of the Holland submarine boat, which has been highly developed here, and his wide experience in this line of work peculiarly qualifies him to talk on the subject. His lecture is very comprehensive and of special interest to those interested in electrical matters because of the status of electricity in relation to the problem of submarine navigation. Mr. Holland believes that for transatlantic travel submarine boats will never be possible commercially. For short trips, however, he thinks it offers commercial advantages that will make it a rival of the surface-going vessel. As an example of such a trip he mentions the English Channel.

As to the motive power for such craft Mr. Holland states that none has been found that can be employed under water as well as electricity. But to cross the Atlantic and make the same speed, a submarine boat the size of one of the large surface steamers would have to carry storage batteries weighing about six times as much as the vessel herself. Liquid air has been suggested as a motive power, but nothing has as yet been accomplished with it. The expenditure for power, therefore, stands as an absolute bar to commercial traffic across the ocean under water.

Mr. Holland states that experience has taught us that submarine navigation is the safest method of travel that we have. In order to give an idea of how modern submarine boats are operated he gives a brief description of the *Gymnote*, which received much attention some years ago. This craft is 56½ ft. long by 6 ft. maximum diameter. A 52-hp electric motor drives the boat at the rate of 9 to 10 knots an hour. The motor gets its current supply from 540 storage cells, and an electric pump is employed to empty and fill the forward and after ends of the boat with water ballast. With a speed of 10 knots she is said to have a radius of action of 45 miles. Mr. Holland concluded his lecture by pointing out the effectiveness of submarine boats in warfare. How the menace of the submarine is to be met is a problem with which great minds are wrestling.

Elecctrical Appliances in Egypt.

The imports of electrical, telegraphic, telephonic and other electrical apparatus into Egypt during 1903 was valued at $338,900, of which amount $2,585 is credited to the United States.

Single-Phase Commutator Motors.—I.

BY SEIJIRO SUGIYAMA.

THE recent demand for an alternating-current railway system has developed many types of the single-phase commutator motor. In general its characteristics are similar to those of the direct-current series motor. That is, its current and its torque are maximum at starting, decrease with increase of speed, and its efficiency and power factor are fairly high over a wide range of speed, which speed extends far beyond synchronism. In construction it is an induction motor, having a direct-current armature as rotor. The following is a determination of its characteristics by the excellent method of Prof. C. P. Steinmetz.

Let Θ = the angle between the magnetic axes of two coils, A and B, the axes of the coils being fixed in space;
S = the ratio of the speed of the coil, A, to synchronism,
$Y = g + jb$ = the exciting admittance of the coil, A, and
$I = i\cos\alpha + ji\sin\alpha$ = the current in the coil, B, reduced to that of the coil, A.

Decomposing the alternating m.m.f. of the assumed sinusoidal distribution into two rotary m.m.f's of half amplitude, rotating in opposite directions, the e.m.f's of the coil, A, induced by the forward and the backward rotating m.m.f., due to the coil B, are, respectively,

$$-\frac{1-S}{2(g+jb)}\{i\cos(\alpha+\Theta)+ji\sin(\alpha+\Theta)\}.$$

and $$-\frac{1+S}{2(g+jb)}\{i\cos(\alpha-\Theta)+ji\sin(\alpha-\Theta)\}.$$

Therefore, the e.m.f. of the coil, A, induced by the alternating m.m.f. of the coil B, is:

$$-\frac{\cos\Theta}{g+jb}(i\cos\alpha+ji\sin\alpha)$$
$$-\frac{S\sin\Theta}{g+jb}(i\sin\alpha-ji\cos\alpha)$$
$$=-\frac{I\cos\Theta}{Y}+jS\frac{I\sin\Theta}{Y}.$$

The first part of the e.m.f., which is independent of the speed, may be called the e.m.f. of alternation; and the second part, which is proportional to the speed, the e.m.f. of rotation. Evidently, the

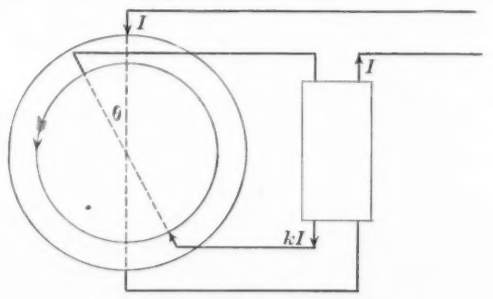


FIG. 1.—PLAIN SERIES MOTOR.

power developed by the rotation of a coil is the product of the e.m.f. of rotation and the current of the coil. The torque is the power divided by the speed.

Here the e.m.f. and the current are of the circuit full frequency, and the power and the torque of double frequency, since the coils are fixed in space.

(1) THE SINGLE-PHASE SERIES MOTOR.

A single-phase commutator motor, with stator and rotor coils in series, is shown diagrammatically in Fig. 1.

Let, in vector denotation,
E = the impressed e.m.f.,
I = the stator current,
kI = the rotor current, reduced to the stator;
$Y = g + jb$ = the exciting admittance,
$Y_0 = g_0 + jb_0$ = the stator admittance,
$Y_1 = g_1 + jb_1$ = the rotor admittance, reduced to the stator,
$c_0 = Y/Y_0$,
$c_1 = Y/Y_1$,
Θ = the angle between the stator and the rotor axis, and
S = the ratio of the speed to synchronism;
then the fundamental equation is:

$$\frac{I-kI\cos\Theta}{Y}+\frac{I}{Y_0}+k\left\{\frac{kI-I\cos\Theta+jSI\sin\Theta}{Y}+\frac{kI}{Y_1}\right\}=E.$$

Therefore, the stator current is

$$I=\frac{EY}{1-2k\cos\Theta+k^2+C_0+k^2C_1+jSk\sin\Theta},$$

the power is

$$P=jS\frac{I\sin\Theta}{Y}\times kI,$$

and the torque is

$$T=j\frac{I\sin\Theta}{Y}\times kI.$$

(2) THE SINGLE-PHASE SHUNT MOTOR.

A single-phase commutator motor, with stator and rotor coils in parallel, is shown diagrammatically in Fig. 2.

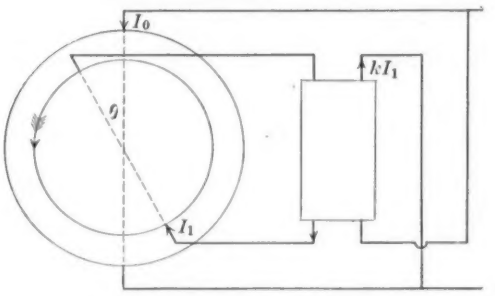


FIG. 2.—PLAIN SHUNT MOTOR.

Let, in vector denotation,
E = the stator impressed e.m.f.,
kE = the rotor impressed e.m.f., reduced to the stator;
I_0 = the stator current,
I_1 = the rotor current, reduced to the stator, and
$I = I_0 + kI_1$ = the line current;
then the fundamental equations are:

$$\frac{I_0-I_1\cos\Theta}{Y}+\frac{I_0}{Y_0}=E$$

and $$\frac{I_1-I_0\cos\Theta+jSI_0\sin\Theta}{Y}+\frac{I_1}{Y_1}=kE;$$

that is, $$I_0(1+C_0)-I_1\cos\Theta=EY$$

and $$I_0(jS\sin\Theta-\cos\Theta)+I_1(1+C_1)=kEY.$$

Solving the simultaneous equations, we have

$$I_0=\frac{1+C_1+k\cos\Theta}{(1+C_0)(1+C_1)-\cos^2\Theta+jS\sin\Theta\cos\Theta}EY,$$

$$I_1=\frac{k+kC_0+\cos\Theta-jS\sin\Theta}{(1+C_0)(1+C_1)-\cos^2\Theta+jS\sin\Theta\cos\Theta}EY,$$

$$I=\frac{1+2k\cos\Theta+k^2+C_1+k^2C_0-jSk\sin\Theta}{(1+C_0)(1+C_1)-\cos^2\Theta+jS\sin\Theta\cos\Theta}EY,$$

$$P=jS\frac{I_0\sin\Theta}{Y}\times I_1,$$

and $$T=j\frac{I_0\sin\Theta}{Y}\times I_1.$$

(3) THE SINGLE-PHASE REPULSION MOTOR.

A single-phase repulsion motor is a single-phase shunt motor having no impressed e.m.f. in the rotor coil, as shown diagrammatically in Fig. 3.

Putting $k = 0$ in the solutions of the single-phase shunt motor, we get

$$I_0 = \frac{1 + C_1}{(1 + C_0)\ (1 + C_1) - \cos^2\theta + j\,S \sin\theta \cos\theta} E\,Y,$$

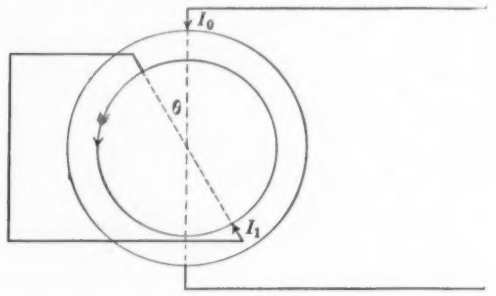


FIG. 3.—PLAIN REPULSION MOTOR.

$$I_1 = \frac{\cos\theta - j\,S \sin\theta}{(1 + C_0)\ (1 + C_1) - \cos^2\theta + j\,S \sin\theta \cos\theta} E\,Y,$$

$$P = j\,S \frac{I_0 \sin\theta}{Y} \times I_1,$$

and $$T = j \frac{I_0 \sin\theta}{Y} \times I_1.$$

The single-phase repulsion motor may be connected in the way shown diagrammatically in Fig. 4.

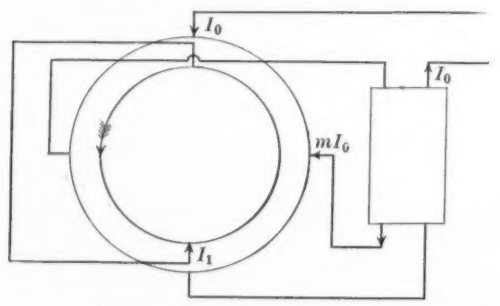


FIG. 4.—SPECIAL REPULSION MOTOR.

Let, in vector denotation,
I_0 = the main stator current and
$m I_0$ = the auxiliary stator current;
then the fundamental equations are:

$$\frac{I_0 - I_1}{Y} + \frac{I_0}{Y_0} + m \left\{ \frac{m I_0}{Y} + \frac{m I_0}{Y_0} \right\} = E$$

and $$\frac{I_1 - I_0 + j\,S\,m\,I_0}{Y} + \frac{I_1}{Y_1} = 0;$$

that is, $$(1 + C_0)\ (1 + m^2)\ I_0 - I_1 = E\,Y$$

and $$(1 + C_1)\ I_1 - (1 - j\,S\,m)\ I_0 = 0.$$

Solving the simultaneous equations, we get

$$I_0 = \frac{1 + C_1}{(1 + C_0)\ (1 + C_1)\ (1 + m^2) - (1 - j\,S\,m)} E\,Y,$$

$$I_1 = \frac{1 - j\,S\,m}{(1 + C_0)\ (1 + C_1)\ (1 + m^2) - (1 - j\,S\,m)} E\,Y,$$

$$P = j\,S \frac{m\,I_0}{Y} \times I_1$$

and $$T = j \frac{m\,I_0}{Y} \times I_1.$$

Putting $m = \tan\theta$ in the above solutions, we get

$$I_0 = \frac{(1 + C_1) \cos^3\theta}{(1 + C_0)\ (1 + C_1) - \cos^2\theta + j\,S \sin\theta \cos\theta} E\,Y,$$

$$I_1 = \frac{(\cos\theta - j\,S \sin\theta) \cos\theta}{(1 + C_0)\ (1 + C_1) - \cos^2\theta + j\,S \sin\theta \cos\theta} E\,Y,$$

$$P = j\,S \frac{I_0 \tan\theta}{Y} \times I_1$$

and $$T = j \frac{I_0 \tan\theta}{Y} \times I_1.$$

Thus, the single-phase repulsion motors, shown in Figs. 3 and 4, have similar characteristics.

(4) THE WINTER-EICHBERG MOTOR.

To improve the power factor of the single-phase repulsion motor,

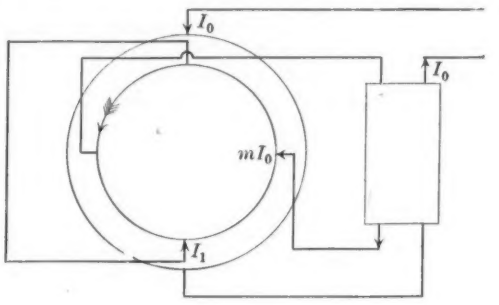


FIG. 5.—WINTER-EICHBERG SERIES REPULSION MOTOR.

the auxiliary rotor coil may be used instead of the auxiliary stator coil, by providing it with two sets of brushes, as shown diagrammatically in Fig. 5.

Let, in vector denotation,
I_1 = the main rotor current reduced to the stator and
$m I_0$ = the auxiliary rotor current reduced to the stator;
then the fundamental equations are:

$$\frac{I_0 - I_1}{Y} + \frac{I_0}{Y_0} + m \left\{ \frac{m\,I_0 + j\,S\,(I_0 - I_1)}{Y} + \frac{m\,I_0}{Y_1} \right\} = E$$

and $$\frac{I_1 - I_0 + j\,S\,m\,I_0}{Y} + \frac{I_1}{Y_1} = 0;$$

that is,

$$(1 + m^2 + C_0 + C_1 m^2 + j\,S\,m)\ I_0 - (1 + j\,S\,m)\ I_1 = E\,Y$$

and $$(1 + C_1)\ I_1 - (1 - j\,S\,m)\ I_0 = 0.$$

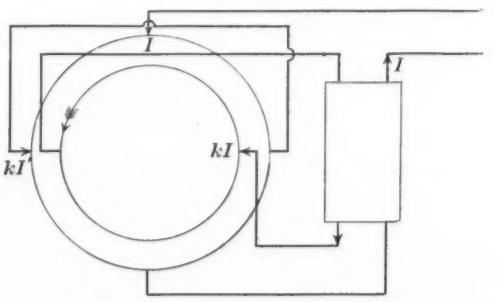


FIG. 6.—EICKEMEYER INDUCED COMPENSATED SERIES MOTOR.

Solving the simultaneous equations, we obtain

$$I_0 = \frac{1 + C_1}{(1 + m^2 + C_0 + C_1 m^2 + j\,S\,m)\ (1 + C_1) - (1 + S^2 m^2)} E\,Y,$$

$$I_1 = \frac{1 - j\,S\,m}{(1 + m^2 + C_0 + C_1 m^2 + j\,S\,m)\ (1 + C_1) - (1 + S^2 m^2)} E\,Y,$$

$$P = j\,S \frac{m\,I_0}{Y} \times I_1 + j\,S \frac{I_0 - I_1}{Y} \times m\,I_0$$

and

$$T = j \frac{m\,I_0}{Y} \times I_1 + j \frac{I_0 - I_1}{Y} \times m\,I_0.$$

As seen, the Winter-Eichberg single-phase repulsion motor may be so controlled as to give unity power factor in any speed beyond

synchronism. The larger the ratio, m, the lower the speed at which unity power factor is obtained.

(5) THE SINGLE-PHASE SERIES MOTOR WITH DAMPER COIL.

The single-phase series motor, having $k = 1$, the single-phase shunt motor, the single-phase repulsion motor and the Winter-Eichberg motor have similar characteristics, with the same displacement, Θ or $tan^{-1} m$. In general, the best displacement, with high efficiency,

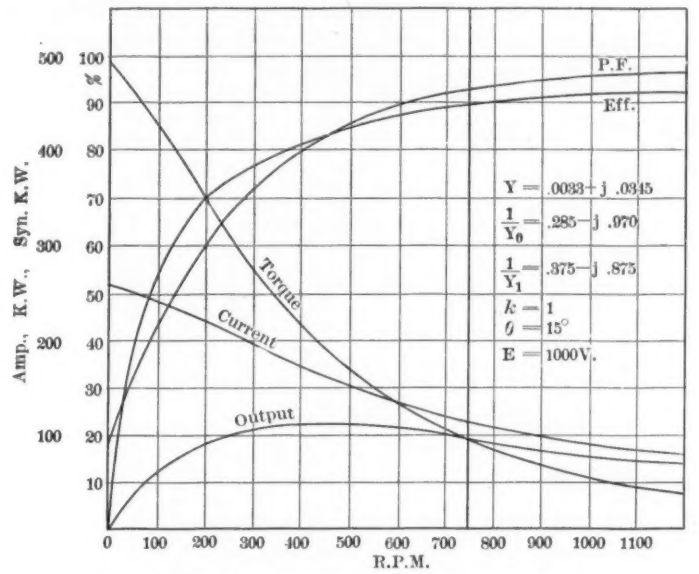


FIG. 7.—CHARACTERISTICS OF PLAIN SERIES MOTOR.

high power factor and large starting torque per kilovolt-ampere input, is smaller than 20°. The constants of the single-phase series motor, having the displacement of 90°, are inherently poor. To

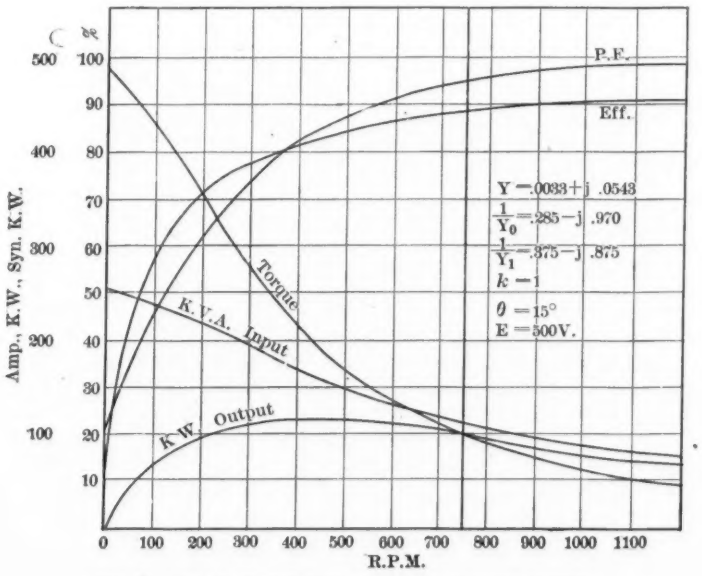


FIG. 8.—CHARACTERISTICS OF PLAIN SHUNT MOTOR.

improve these, the Eickemeyer single-phase series motor has a stator damper coil, in the same axis as the rotor coil. It is shown diagrammatically in Fig. 6.

Let, in vector denotation,

$k I'$ = the current of the damper coil, reduced to that of the stator;

Y' = the admittance of the damper coil, reduced to that of the stator, and

$C' = Y/Y'$;

then the fundamental equations are:

$$\frac{I}{Y} + \frac{I}{Y_0} + k \left\{ \frac{k I - k I' + j S I}{Y} \quad \frac{k I}{Y_1} \right\} = E$$

and

$$\frac{I' - I}{Y} + \frac{I'}{Y'} = 0;$$

that is, $(1 + k^2 + C_0 + k^2 C_1 + j S k)\, I - k^2 I' = E Y$

and $(1 + C')\, I' - I = 0.$

Solving the simultaneous equations, we have

$$I = \frac{1 + C'}{(1 + C')\ (1 + k^2 + C_0 + k^2 C_1 + j S k) - k^2} E Y,$$

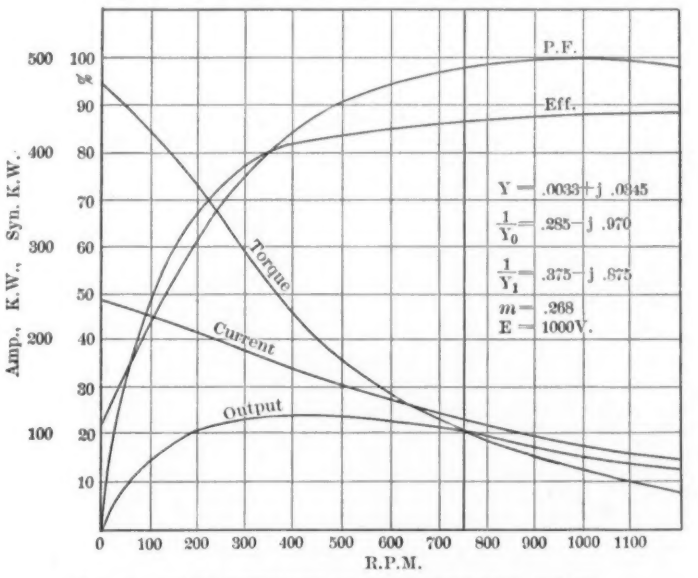


FIG. 9.—CHARACTERISTICS OF PLAIN REULSION MOTOR.

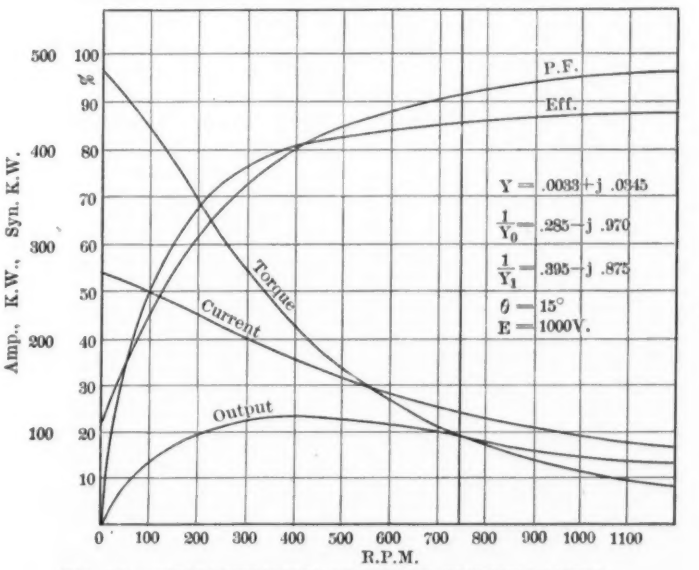


FIG. 10.—CHARACTERISTICS OF WINTER-EICHBERG MOTOR.

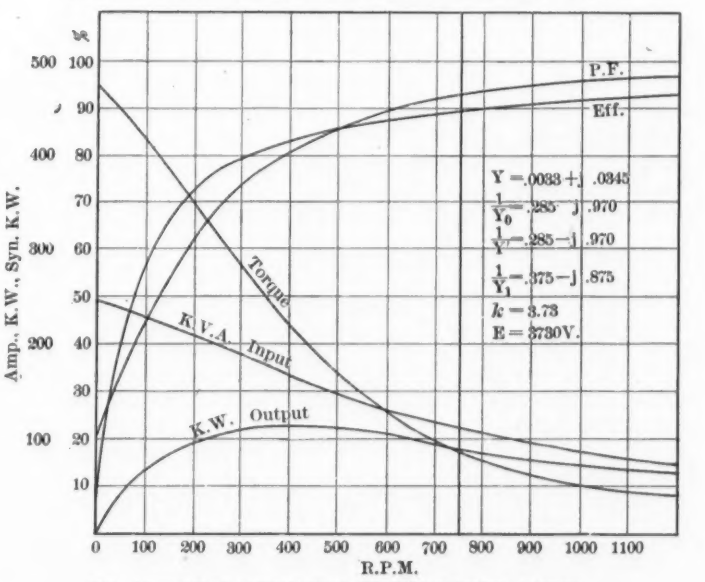


FIG. 11.—CHARACTERISTICS OF EICKEMEYER MOTOR.

$$I' = \frac{I}{(1 + C')\ (1 + k^2 + C_0 + k^2 C_1 + j S k) - k^2} E Y,$$

$$P = j S \frac{I}{Y} \times k I$$

and $T = j\frac{I}{Y} \times kI.$

As examples, the calculated characteristics of single-phase railway motors of the latest designs, according to the various motors mentioned above, are shown in Figs. 7, 8, 9, 10 and 11, each motor being four-polar and operating on 25-cycle current, thus the synchronous speed is 750 r.p.m., as shown.

Resistance Boxes for Use in Precise Alternating Current Measurements.

BY GEO. A. CAMPBELL, PH.D.

RESISTANCE is, according to definition, an impedance such that with any impressed electromotive force whatever between its terminals the resulting current is at every instant exactly proportional to the electromotive force. This ideal resistance cannot be completely realized in practice. So close an approach to the ideal may, however, be attained as to be entirely sufficient for a large and most important class of work with alternating currents.

It has been customary where resistances were to be used with alternating currents of high periodicity so to arrange the coils that the capacity between the halves of the wire of each coil should be as small as practical without greatly increasing the self-induction of the winding. It does not seem to have been sufficiently appreciated that better results can be obtained by suitably proportioning the capacity and the inductance than by merely making each of them as small as possible. It is easy to show that the inductance, even when reduced to its minimum, is not sufficiently small to be negligible in refined work. We can make an estimate of the inductance of a coil wound in the ordinary non-inductive manner by computing the inductance of an infinite system of parallel equi-distant round wires lying in a plane and carrying currents alternately in opposite directions. The self-induction of a portion of such a wire of diameter d, length l and distance on centers c is

$$L = l\left\{4\,log\,\frac{4c}{\pi d} + 1\right\}$$

which is equivalent to

$$L = l\,\{\,.0116971\,log_{10}\,(c/d) + .00249714\,\}$$

if the inductance is measured in micro-henries and the total length of wire in inches. The use of this formula implies, of course, that each layer of the resistance coil has a large number of turns, that the diameter of the winding is large compared with the distance on centres of the wire, and, also, that there is no mutual induction between layers. This last will be approximately true since adjacent layers are wound in opposite directions and so cross each other at an angle, thus making as much negative as positive mutual inductance between adjacent layers. The numerical magnitudes involved are shown in the following table which has been computed for Ia Ia wire with a frequency of 1,000 cycles per second, and the above formula for the self-induction. The table is made assuming both an insulation of negligible thickness and an insulation of double silk 4 mils in thickness.

Values of $\frac{Lw}{R}$ *for double wound coils of Ia Ia wire with frequency of 1000 cycles per second.*

B. & S. Gauge.	Insulation Negligible.	Insulation 4 Mils.
18	1014.10^{-6}	1386.10^{-6}
24	252 "	424 "
30	63 "	128 "
36	16 "	46 "

Under favorable conditions the impedance measurements with induction balance may be made to ten parts in a million, and in a great deal of work of commercial character it is desirable to obtain results correct to within at least one hundred parts to a million. This is brought about, not by the necessity of measuring the total impedance to this degree of precision, but by the necessity of measuring one of the components—either the resistance or the reactance component—to a moderate degree of precision where it is associated with a much larger complimentary component. On this account, the reactance component of a resistance cannot be considered negligible unless it is as small as 1/100,000 part of the resistance component. With this understanding, the table above shows that the inductance of a resistance coil cannot be made negligible even for frequencies of 1,000 cycles per second, since it is not desirable to use wires finer than No. 30 or No. 36 in the construction of standard coils. For higher frequencies or for coils which are not wound strictly non-inductively, the deviations are very much larger than those indicated in the table. This will serve to show the necessity of taking account of the residual inductance in resistance coils intended for precise use with alternating currents of high frequency.

Since it is impossible to eliminate entirely the inductance and capacity of a resistance coil, the alternative is to offset one by the other in case that is possible. A theoretical investigation of the subject shows that this is possible under certain definite conditions. By following these theoretical requirements it is practicable to construct resistance standards of the necessary precision for the practical cases which arise in telephonic investigations. Vaschy suggested the possibility of such compensation (*Traité d'Électricité et de Magnétisme*, Vol. II, pp. 8-11, 1890), but did not develop the idea. He considered the integral current flowing in charge and discharge rather than the behavior of alternating currents, which is the case considered here.

The theory of the subject is comparatively simple and may be indicated briefly as follows:

Consider a resistance, R, shunted by a condenser of capacity C, with an impressed electromotive force at $\omega/2\pi$ cycles per second. The impedance of the combination will be

$$\frac{R}{1 + R\,C\,\omega\,j},$$

which may be written in the form:

$$\frac{R}{1 + (R\,C\,\omega)^2} - \frac{R^2\,C\,\omega\,j}{1 + (R\,C\,\omega)^2}$$

In case the value of $(R\,C\,\omega)^2$ is negligible in comparison with unity, this reduces to

$$R - R^2\,C\,\omega\,j$$

In this case, therefore, the effect of the capacity is identical with that of a *negative* inductance for all frequencies up to the highest at which $(R\,C\,\omega)^2$ is negligible compared to unity. The proposed method of constructing an ideal resistance having neither capacity nor inductance reactance is based upon this relation. If an inductance, L, is added in series with the combination of resistance and capacity, the impedance of the combination will be

$$R + (L - R^2\,C)\,\omega\,j$$

and if L, C and R are so adjusted that $L = R^2\,C$, the reactance term vanishes and the resistance becomes reactanceless.

In the actual resistance coil the entire capacity will not be shunted across the end of the resistance, but will be distributed throughout the coil. The inductance will also be distributed. The simplest case for mathematical treatment is that of an ordinary transmission line in which the capacity and inductance are uniformly distributed along two parallel wires. Theory shows that if R, C, L are the total resistance, total capacity and total inductance, respectively, uniformly distributed with respect to each other, and the frequency is $\omega/2\,\pi$ cycles per second, the impedance of the circuit when short-circuited at the farther end will be equal to

$$Z = \sqrt{\frac{R + L\,\omega\,j}{C\,\omega\,j}}\,tanh\,\sqrt{(R + L\,\omega\,j)\,C\,\omega\,j}$$

In case the value of $(R^2 + L^2\,\omega^2)\,C\,\omega^2$ is smaller than $(\pi/2)^4$, the expression may be expanded in the following series:

$$Z = (R + L\,\omega\,j)\left(1 - \frac{1}{3}\left\{(R + L\,\omega\,j)\,C\,\omega\,j\right\} + \frac{2}{5}\left\{(R + L\,\omega\,j)\,C\,\omega\,j\right\}^2 - \frac{17}{315}\left\{(R + L\,\omega\,j)\,C\,\omega\,j\right\}^3 + \ldots\right)$$

and in case the values of $L\,\omega/R$ and $R\,C\,\omega$ are sufficiently small, all terms except those of the first order may be neglected, making

$$Z = R + (L - R^2\,C/3)\,\omega\,j.$$

The condition that the inductance and capacity balance and neutralize each other is, therefore, in this case,

$$L = \frac{R^2 C}{3}$$

This shows that uniformly distributed capacity has ⅓ of the effect of capacity shunted at the terminals, provided the capacity and inductance are sufficiently small compared with the resistance.

A general investigation of the subject shows, as is indicated by the results given above, that the impedance of a resistance coil is equal to

$$Z = R - \Sigma\, r^2 s + (L - \Sigma\, r^2 c)\, \omega\, j$$

where R is the total resistance of the wire, L is the total inductance, r is the resistance between two points shunted by the direct capacity c or the direct conductance s; the summations to include all direct capacities and conductances in the resistance (the direct capacities here referred to are ordinarily spoken of as the mutual capacities in theoretical treatises).

In order to determine the limit within which the capacity may be treated as a negative inductance, we must examine the terms of higher order in the expansion of the impedance formula. In case a capacity C is shunted across a resistance R and an inductance L, in series, we have

$$Z = \frac{R + L\omega j}{1 + (R + L\omega j)\, C\omega j} \text{ and if } L = R^2 C \text{ this becomes}$$

$$= R \frac{1 + RC\omega j}{1 + (1 + RC\omega j)\, RC\omega j}$$

$$= R\left(1 + (RC\omega)^2 - (RC\omega)^3 j \ldots\ldots\right)$$

If the inductance and capacity are uniformly distributed

$$Z = \sqrt{\frac{R + L\omega j}{C\omega j}}\, \tanh \sqrt{(R + L\omega j)\, C\omega j}$$

$$= R + (L - R^2 C/3)\, \omega j + 2\,(L/3 - R^2 C/15)\, RC\omega^2 +$$

$$(L^2/3 - 2R^2 LC/5 + 17R^4 C^2/315)\, C\omega^3 j + \ldots\ldots$$

If the first order term vanishes $L = R^2 C/3$ and substituting this value for L we obtain the expression

$$Z = R\left(1 + \frac{4}{45}(RC\omega)^2 - \frac{8}{189}(RC\omega)^3 j + \ldots\ldots\right)$$

In case an absolute accuracy of one part in a is necessary, then the first term in these expressions must not be greater than $1/a$. In many cases the absolute value of the resistance component is not so important as the value of the reactance component. In those cases the third order term establishes the limiting value of the capacity. Thus if the capacity is shunted across the terminal of the resistance, its maximum allowable value will be equal to

$$1/R\omega \sqrt[2]{a} \text{ or } 1/R\omega \sqrt[3]{a}$$

according as the resistance or the reactance component furnishes the criterion. If the capacity and inductance are uniformly distributed these values are to be multiplied by

$$\sqrt{\frac{45}{4}} \text{ and } \sqrt[3]{\frac{189}{8}} \text{ respectively}$$

each of which is equal approximately to 3.

After having made a single standard box of reactanceless resistances, other boxes may be made by comparison and adjustment. If the first standard box is to be made up of wire, then the coils must be wound in such a manner as to permit the computation or measurement of the inductance of each winding and of the capacity. This is readily accomplished by making the spools of such diameter that the formula given above for the inductance may be employed. It is, of course, also possible to use carbon resistances for this primary standard.

The completed resistance must be enclosed in a suitable static shield in order to make all the capacity shunts perfectly definite. This may be a shield entirely surrounding the coil and connected to one of the terminals. The capacity of the coil to the shield is to be measured and allowed for in the formula as well as the other capacities. Of course the distribution of this capacity must be known. If, after the construction of the resistance, it is found that there is not sufficient capacity, this may be corrected by the addition of capacity shunted across the terminals. A convenient manner of adding this is to have two wires wound on the same spool extending

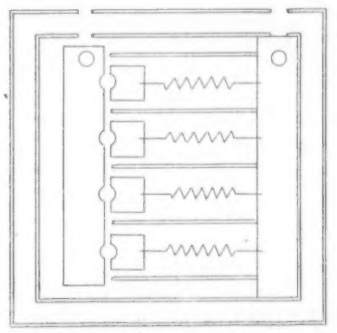


FIG. 1.—ARRANGEMENT OF COILS IN PARALLEL.

from the open end of the resistance. By unwinding more or less of one or both of these wires the capacity can be reduced at pleasure. As this capacity is located across the terminals of the resistance it gives the maximum compensation with a minimum of capacity. It is apparently better practice to adjust in this manner by means of capacity, but in case it is necessary to use a coil having excessive capacity, the reactance may be corrected by adding inductance.

In the construction of working resistances of high value it is

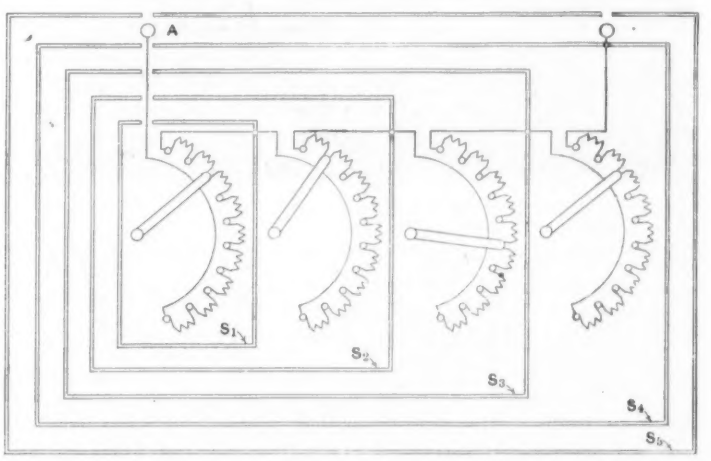


FIG. 2.—ARRANGEMENT OF COILS IN SERIES.

more economical of labor and space to wind the coils in small sections, as resistance coils are ordinarily wound; that is, non-inductively, and connect them in series to make the desired units, and then adjust by adding capacity or inductance to eliminate all reactance.

Fig. 1 shows the arrangement of a number of coils for use in parallel. This figure shows each coil separately shielded and with this arrangement the admittance of two or more coils is exactly equal to the sum of the admittances of the individual coils.

Fig. 2 shows the arrangement for coils in series. The requirement here is that each of the sets of coils must be surrounded by a shield surrounding all sets of coils which precede. This arrangement insures that two or more sets of coils in series shall have an impedance equal to the sum of the impedances of the indivdual sets of coils, provided the capacity of terminal A to the intermediate shields is sufficiently small. The capacities between the shields $S_1 S_2 \ldots\ldots S_4$ are to be included in the adjustment of the coils.

Platinum.

The Russian platinum mines in 1903 produced 13,210 pounds (avoirdupois) or 6⅗ short tons. This is a decrease of 258 pounds as compared with the previous year's product. Most of the output was exported in the form of crude material. The output in 1902 was 13,477 pounds.

Magnetic Testing of Iron and Steel.

From the report of the Committee of the American Society for Testing Materials, appointed to investigate the magnetic testing of iron and steel, have been taken the following statements, which will be of interest to all concerned with the manufacture and the use of iron and steel for electrical purposes.

As the accuracy of nearly all methods for making magnetic determinations depends upon a comparison with some standard method, it seemed desirable to exploit to some degree the methods for making absolute determinations. The most common, and in the hands of a skilled operator, the most reliable, method for making absolute determinations of magnetic data is by use of a ballistic galvanometer. It appears also that the Rowland ring method is the one most commonly used in connection with the galvanometer method.

Experiments have been conducted with a view to obtaining information concerning (1) the accuracy of different methods of standardizing the instrument; (2) a comparison of results obtained

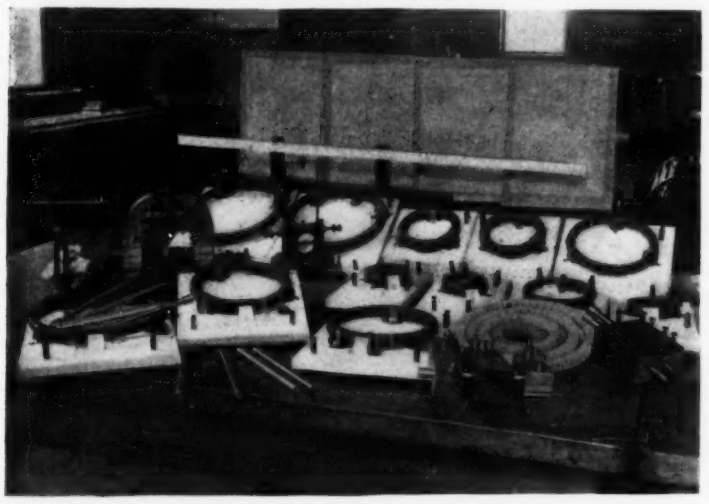


FIG. 1.—MOUNTING OF TEST RINGS.

using specimens of varying size; (3) the possibility of obtaining samples of the same quality from a single casting, and (4) a detection of possible errors in the method.

In preparing the specimens a flat plate of steel 1½ in. thick and 14 in. in diameter was obtained. This plate was cast horizontally in the mold in order to secure as uniform a density as possible and was used in the unannealed condition. From this plate were cut two sets of four concentric rings, i. e., the plate was split in halves and from each half were cut four rings of the same cross-section and the following dimensions:

Cast Steel Ring No. 1a.

Outer diameter	10.18 cm.
Mean diameter	8.58 cm.
Height	1.60 cm.
Cross section area	2.572 sp. cm.
Primary turns	154
Secondary turns	50 to 1

Cast Steel Ring No. 1b.

Outer diameter	10.212 cm.
Mean diameter	8.601 cm.
Height	1.616 cm.
Cross section area	2.598 sq. cm.
Primary turns	153
Secondary turns	50 to 1

Cast Steel Ring No. 2a.

Outer diameter	16.19 cm.
Mean diameter	14.59 cm.
Height	1.574 cm.
Cross section area	2.472 sq. cm.
Primary turns	286
Secondary turns	50 to 1

Cast Steel Ring No. 2b.

Outer diameter	16.193 cm.
Mean diameter	14.601 cm.
Height	1.590 cm.
Cross section area	2.537 sq. cm.
Primary turns	293
Secondary turns	50 to 1

Cast Steel Ring No. 3a.

Outside diameter	22.19 cm.
Mean diameter	20.61 cm.
Height	1.61 cm.
Cross section area	2.561 sq. cm.
Primary turns	451
Secondary turns	50 to 1

Cast Steel Ring No. 3b.

Outside diameter	22.19 cm.
Mean diameter	20.61 cm.
Height	1.62 cm.
Cross section area	2.575 sq. cm.
Primary turns	450
Secondary turns	50 to 1

Cast Steel Ring No. 4a.

Outside diameter	28.24 cm.
Mean diameter	26.65 cm.
Height	1.601 cm.
Cross section area	2.619 sq. cm.
Primary turns	592
Secondary turns	50 to 1

Cast Steel Ring No. 4b.

Outside diameter	22.19 cm.
Mean diameter	20.61 cm.
Height	1.62 cm.
Cross section area	2.575 sq. cm.
Primary turns	450
Secondary turns	50 to 1

Each ring was wound uniformly with one layer of No. 18 B. & S. double cotton-covered wire over a layer of insulating tape lapped one-half. This constituted the primary winding. Over this winding was placed a secondary coil of fifty turns. The insulation between the primary and secondary windings consisted of a layer of mica and the latter winding was composed of No. 36 double silk-covered German silver wire, German silver being used in order that changes in the temperature, on account of its low temperature coefficient, might not affect the resistance of the secondary circuit and consequently the results.

As shown in Fig. 1, the several rings were mounted on suitable bases and the terminals of the primary and secondary windings connected to binding posts. For reasons which will be discussed further on, the secondary winding was connected in the following manner: Taps were made at the end of the 1st, 2d, 3d, 5th, 10th, 15th, 20th, 30th, 40th and 50th turns and carried to small binding posts connected with mercury cups, as shown in Fig. 2. A second row of mercury cups was placed opposite the first and between these was connected a resistance equal to that winding contained between the opposite pair of terminals. The circuit was completed by means of a copper clip connecting opposite columns of mercury. It will be seen that this method makes possible the use of a variable number of secondary turns without altering the resistance of the secondary circuit, which enables the operator to keep the deflections of the galvanometer within the range of the instrument for increasing the flux densities by using a lesser number of secondary turns.

Another casting of steel was obtained and rings were cut from this with dimensions as given in the following table:

Ring.	No. 10.	No. 20.	No. 30.	No. 40.
Outside diameter	9.892	15.164	20.183	25.37
Mean diameter	8.6	13.88	18.84	24.1
Cross section	1.8712	1.8371	1.8307	1.8852
No. of primary turns	181	303	448	588
No. of secondary turns	600	600	600	600

A primary winding of No. 16 B. & S. double cotton-covered wire placed on the specimens and a secondary winding of 600 turns, with taps at the 5th, 10th, 15th, 25th, 40th, 75th, 125th, 200th, 300th, 400th and 600th turns, was wound.

A large number of secondary turns was employed in order to necessitate the use of a high resistance in series with the galvanometer when the whole number of secondary turns was in use, for reasons which will be brought out later.

From this steel plate were cut two bars 10 in. long, which were turned to a diameter of .575 in. These bars were tested in a direct-reading, magnetic testing apparatus shown to the left in Fig. 1. This

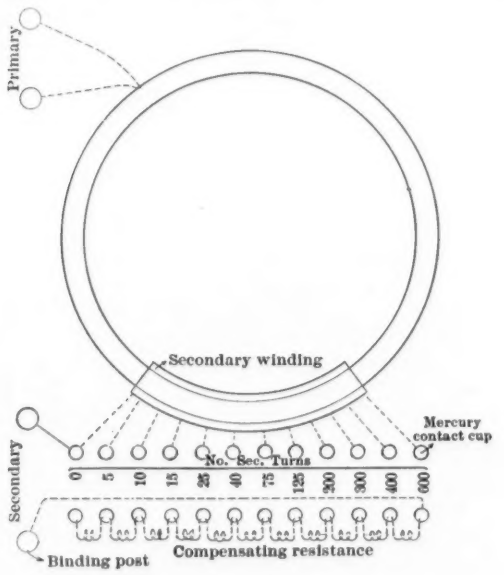


FIG. 2.—DIAGRAM OF RING CONNECTIONS.

gives a comparison between the Rowland ring method and the results given by the apparatus.

The galvanometer used was of the D'Arsonval swinging coil type, the suspensions for which were lengthened to 3½ ft. each, to reduce the effect of torsion. The resistance of the galvanometer coil was approximately 900 ohms. The usual accessories in the way of telescope, commutator, etc., were provided.

For standardizing the instrument a solenoid was constructed consisting of a core of hard red fibre 187 cm. in length and 3.82 cm. outside diameter. This coil carried a primary winding of 1,520 turns of No. 18 B. & S. double cotton-covered wire. The secondary winding of the coil consisted of 2,000 turns of No. 36 B. & S. double

silk-covered wire wound in two layers over a length of 6 in. at the middle of the coil.

A set of standardizing coils was also made in the following manner: After the cast-steel rings were machined to size, a paraffine mold was made from each ring, and from each mold a plaster of paris ring was cast, which received a primary winding similar to that of the specimen and a secondary coil of 600 turns.

The apparatus was connected as shown in Fig. 3. Current was taken from a storage battery to insure steadiness and its value indicated by a standard Weston ammeter.

The galvanometer was adjusted to a period of 24 seconds; each ring was thoroughly demagnetized before taking observations and

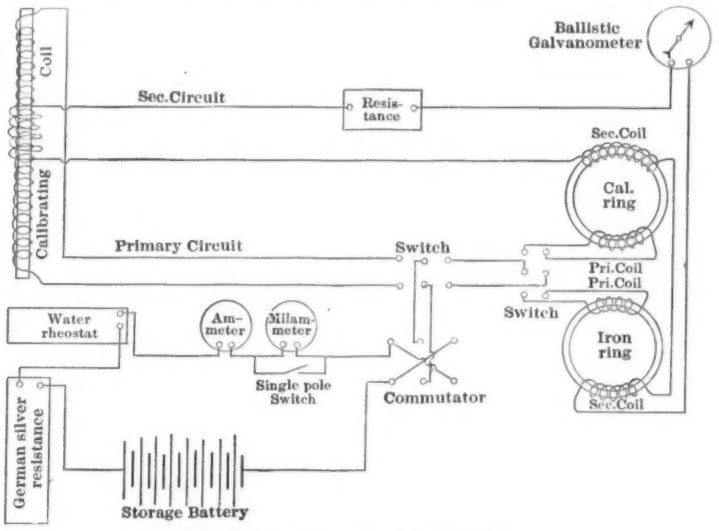


FIG. 3.—DIAGRAM OF CONNECTIONS.

the instrument standardized before and after each test, using the solenoid and a plaster of paris ring of the size of the specimen under test. Each value determined was the result of eight or more readings.

A complete test was carried through on each specimen, maintaining the resistance of the secondary circuit constant, the readings of the instrument being kept within range by the use of a variable number of secondary turns. When the test by this method had been completed, the specimen was demagnetized and tested a second time, using the total number of secondary turns and varying the secondary

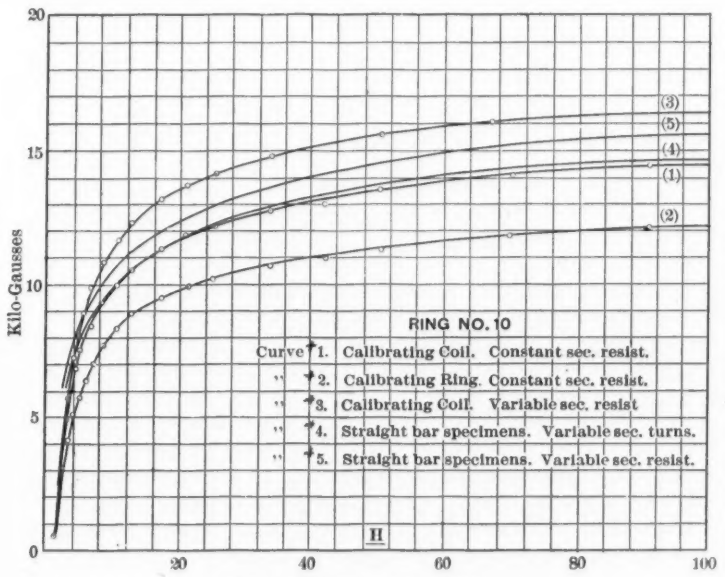

Kilo-Gausses
RING NO. 10
Curve †1. Calibrating Coil. Constant sec. resist.
" †2. Calibrating Ring. Constant sec. resist.
" †3. Calibrating Coil. Variable sec. resist
" †4. Straight bar specimens. Variable sec. turns.
" †5. Straight bar specimens. Variable sec. resist.
H

FIG. 4.—RESULTS OF TESTS.

resistance to keep the readings of the instrument within readable range.

The value of H, the magnetizing force in gilberts per centimeter, was calculated from the well-known equation:

$$H = \frac{4\pi Ni}{10L}.$$

The values of B, the maximum density in gausses, were calculated: (*a*) With constant secondary turns and variable secondary resistances, (*b*) with variable secondary turns and constant secondary resistance, (*c*) with constant secondary resistance, variable secondary turns and plastic ring calibrating coil.

Results.—The results were calculated with great care and the curves plotted as shown in Figs. 4, 5 and 6.

In each case these results indicated a very wide range in the results obtained by the different methods of standardizing, as well as between the tests made using constant and variable secondary resistances. It is clear that the standardizing solenoid using a variable secondary resistance gives in each case the highest values.

This is due to the reduction in the damping of the galvanometer,

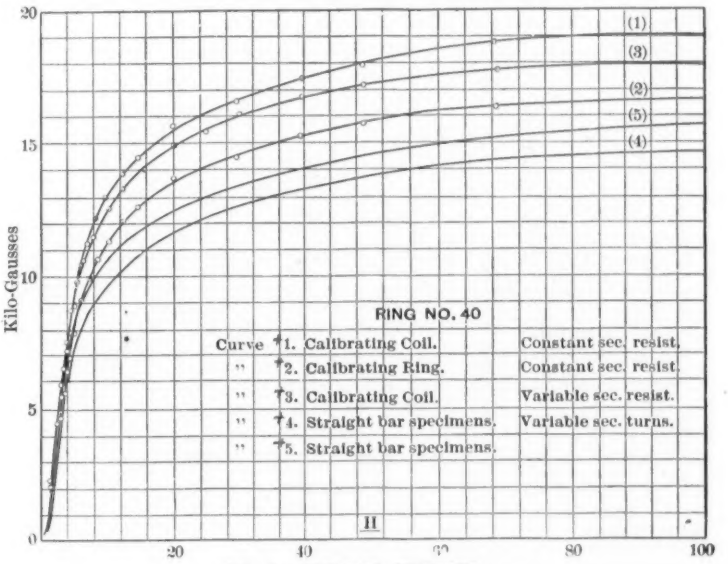

Kilo-Gausses
RING NO. 40
Curve †1. Calibrating Coil. Constant sec. resist.
" †2. Calibrating Ring. Constant sec. resist.
" †3. Calibrating Coil. Variable sec. resist.
" †4. Straight bar specimens. Variable sec. turns.
" †5. Straight bar specimens.
H

FIG. 5.—RESULTS OF TESTS.

with the increased secondary resistance required at the higher densities. The coil of the instrument swinging in the magnetic field acts as a small electric generator tending to drive the current through the secondary circuit. This current reacts upon the magnetic field and tends to stop the motion of the coil. The greater the secondary resistance, the smaller will be the current set up by the motion of the coil, and consequently a reduction in the damping effect. This makes the galvanometer more sensitive as the higher resistances are introduced and gives results which are too high.

Singularly, the calibrating ring consistently gives results which

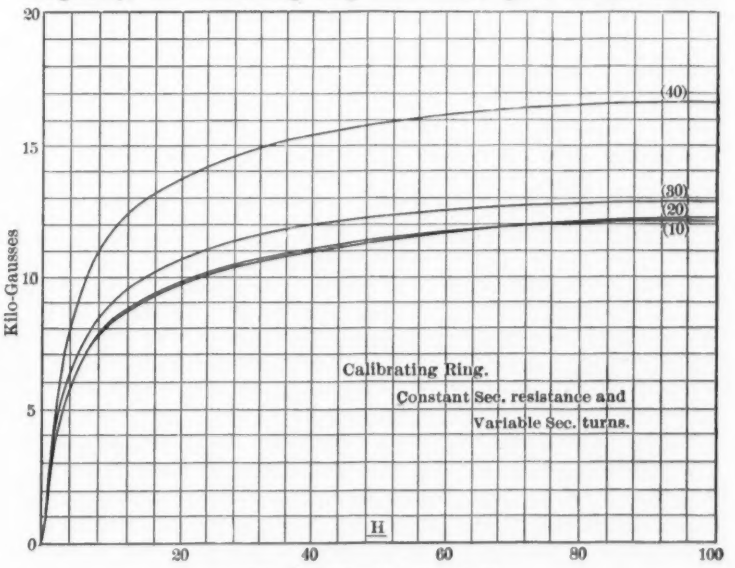


FIG. 6.—RESULTS OF TESTS.

are lower than the average and which differ from those given by the standardizing solenoid by as much as 36 per cent. of the former.

It is interesting to note that in every case the results by the calibrating solenoid with variable secondary turns and constant resistance curve, No. 1, Figs. 4 and 5, check very closely with the tests of the straight bars under similar conditions, as shown by curves No. 4 of the same figures.

When accurate tests of carefully prepared specimens made by the same operator give results which vary as widely as those just referred to, the need of a standard method of testing is apparent.

There is no doubt but that the use of a constant secondary resistance, which may be effected by using a variable number of secondary turns, or by a key which will throw the galvanometer on open circuit as soon as the charge is passed, will result in results of much greater accuracy.

Fig. 6 gives the results obtained from similar tests of the four

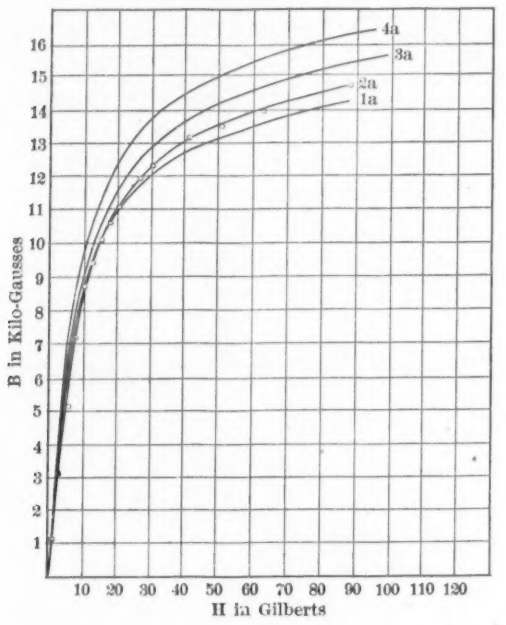


FIG. 7.—RESULT OF TESTS.

rings, Nos. 10, 20, 30 and 40, and shows a wide variation, due, perhaps, to the different sizes of rings and a variation in the quality of the metal in the casting from which the rings were cut, No. 40, the larger ring, giving results which depart widely from those obtained from the other three.

In Figs. 7 and 8 will be found the results of the two sets of four rings cut from each half of the steel casting.

Assuming that these samples are of the same quality, these tests

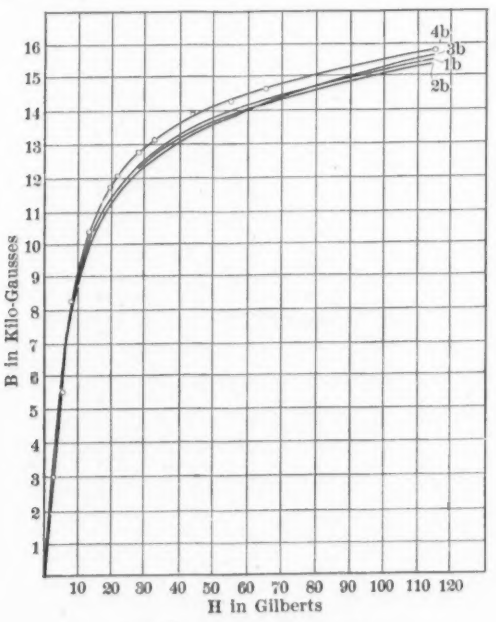


FIG. 8.—RESULT OF TESTS.

indicate the various results obtained from rings of different sizes when tested by similar methods, the smaller rings giving the lower values, the increase being nearly proportional to the increase of the diameter of the specimen and the difference between the maximum of the smallest ring and that of the largest being 14 per cent. of the former.

In the case of the rings taken from the other half of the same casting, the variation is not so marked, which would indicate that the difference between the results shown by the curves in Fig. 6 is due partially to the difference in magnetic quality.

Samples 1a, 2a, 3a and 4a are those cut from the upper half of the plate as it was cast, and it would be expected that the variation in quality in the upper half of the plate would be greater, which may, in a measure, account for the fact that the curves in Fig. 8 do not follow the same law as those in Fig. 7.

The wide difference in the results obtained by varying the size of the specimens and the methods of standardizing the instruments indicate clearly the necessity of adopting a standard specimen and the use of greater care in the calibration of instruments used for magnetic testing.

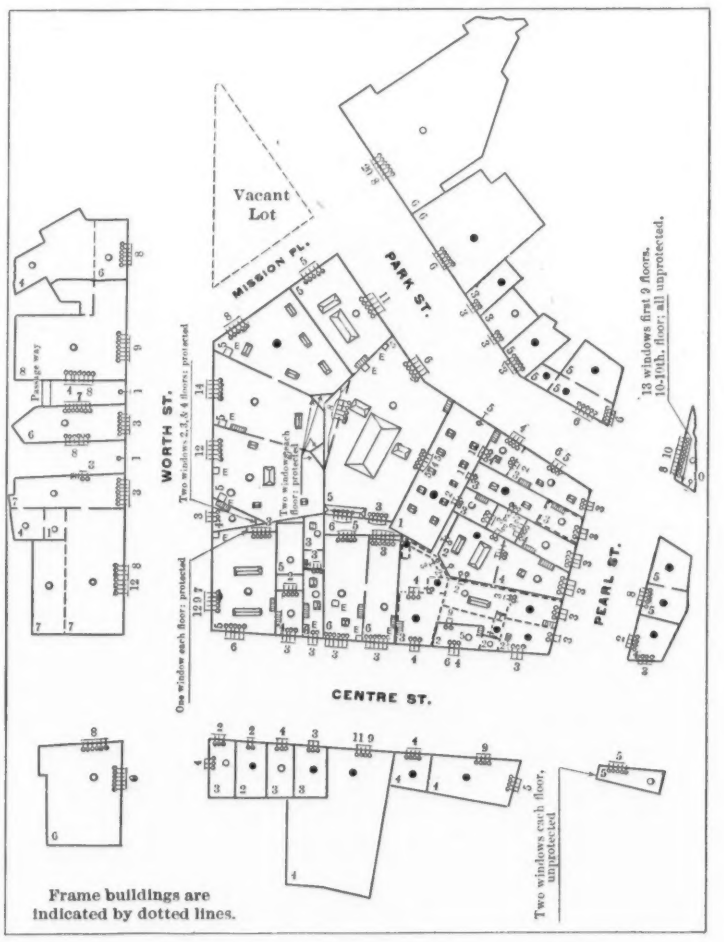
The committee in full has been continued by the society, and the report of future investigations will be received with interest.

Underwriters' Block Survey.

BY JOHN L. DICKSON.

RECOGNIZING the recent but gradually increasing endeavor the various fire insurance companies are making toward the employment of technically trained men for the inspection of fire risks, so as to determine the rate for a building or contents, the water submits what follows for the purpose of illustrating the work recently done by a group of engineers, employed by a well-known fire insurance association.

It being decided to make a complete survey of an entire New York City block, anything and everything was inspected, and a report made as to the condition of the same. Each building in this block was con-



BLOCK SURVEY.

sidered separately and a complete inspection of building and contents made. The electrical installations of the entire block were taken up in detail and it is alarming to note the unsafe conditions prevailing, such as bare wires coming in contact with metal, electric light wires nailed with metal staples to wood, faulty connections, unsafe setting of generators and motors, etc.

The sprinkler systems were found to be in fairly good condition. Fire pails in most cases were half filled with stale and dirty water, while some contained no water. Watchmen's electric time clock recording systems were found in excellent condition. Rubbish and

combustible material were stored recklessly in every nook and corner. In this connection it might be noted that a complete hen house and yard were found on the roof of a certain building. A drawing showing the block with exposures is given in the accompanying illustration, in which the features of each building are shown by various symbols.

Let us consider the building on the corner of Park Street and Mission Place. The rectangles near the center represent skylights; the circle with a line above represents a metal roof (a filled-in-circle is a tar and gravel roof); the rectangle with filled-in parallel lines, in the rear, represents a stairway, while the square with the letter *E* in an adjoining building is an elevator. The opening with curved lines represents a communication with an adjoining building, cut off with standard fire doors; the figure 5 in the upper left-hand corner denotes the height of the building in stories; the straight lines with circle on ends represent the windows. The wall of this building facing Mission Place has five windows on each floor, unprotected; when the windows are protected a curved line is drawn, as shown on some of the other buildings.

The block survey was a complete success, as it brought out important facts not previously known.

A Graphical Method of Representing Voltage Ratios in Synchronous Converters.

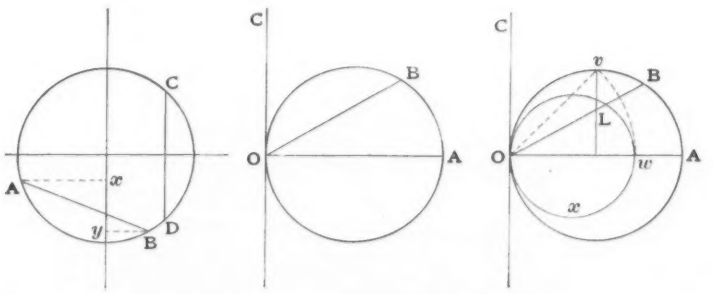
BY O. J. FERGUSON.

A SIMPLE method of deriving the voltage ratios of rotary converters may be of more than passing interest, since it will give in a minute the information often required, but not often remembered.

Without going into a rigorous proof of each step, the derivation of the geometrical diagram may be outlined clearly, as follows:

Assuming a two-pole model of converter, the number of conductors in series between collector rings varies as the arc of the circle included between the rings. Owing to the direction of motion in the field, the summation of these e.m.fs. is equivalent to the vector sum of the infinitesimal components of the arc, or is equivalent to the chord of the arc, e. g., *A B*, Fig. 1.

Owing to the direction of the flux, the activity of this series of conductors is measured by the projection of the arc or its equivalent chord upon a line perpendicular to the direction of the flux,



FIGS. 1, 2 AND 3.—VOLTAGE RATIOS.

e. g., *X Y*, supposing flux to be horizontal. It is evident that the activity is greatest when the chord is perpendicular to the direction of the flux, as at *C D*. This position corresponds to maximum voltage.

The direct-current brushes are 180° apart. Hence the diameter of the circle (Fig. 2) will represent *E*, the direct-current voltage.

On a two-pole model of converter with *n* rings, adjacent rings are $360°/n$ apart. Referring now to Fig. 2, if *O B* is the chord having a value such that arc $OB = 360°/n$, the chord represents the maximum value of the alternating e.m.f. between adjacent rings. It will be apparent from the figure that *OB* can be found, for any given number of rings, from the relation, angle $COB = 180°/n$. *En*, the measurable value of the e.m.f. between adjacent rings, is the mean of effective value of the voltage whose maximum in indicated by *OB*. Hence $Em = \frac{OB}{\sqrt{2}}$.

This value can be found graphically as follows. In Fig. 3, on *OA*, a distance equal to the direct-current e.m.f, draw a circle, *AVO*. Locate the point *V* so that angle $VOA = 45°$, and with *O* as a centre and *VO* as a radius, draw an arc cutting the line *OA* at *W*. *OW* is equal to $OA/\sqrt{2}$, and any chord such as *OL* of the circle *OLWX* will bear a constant ratio to the corresponding chord of the outer circle *OVBA*. That is, $OL = OB/\sqrt{2}$. The line *CO* being perpendicular to *OA*, if the angle *COB* be laid off to equal $\frac{\pi}{n}$ the desired quantities are as follows: $OL = En$ = mean effective voltage between adjacent rings of *n*-ringed synchronous converter, $OB = Emax$ between adjacent rings, $OA = Eo$ = direct-current voltage.

From the figure it is seen that $OL = OW \sin \frac{\pi}{n}$ or $En = \frac{Eo}{\sqrt{2}} \sin . \frac{\pi}{n} = .707\ Eo \sin \frac{\pi}{n}$, which is the well-known equation for finding the e.m.f of an *n*-ringed synchronous converter.

Since the sines of the angles needed for the two, three, four and six-ringed converter are easily recalled, and the derivation of the equation can be mentally pictured from the graphical construction given above, it is believed that the treatment here outlined possesses some interest.

A View of Telegraphic Growth.

The annual report of the Western Union Company, for the fiscal year ending June 30, 1904, shows a surplus of $6,729,775 over fixed charges, equal to 6.9 per cent. on the $97,370,000 stock outstanding. This compares with 7.3 per cent. shown for the stock in the previous fiscal year. The report showed a slight increase in gross earnings, but net earnings fell off $326,997, or about 4 per cent. This probably represents the loss in poolroom business for part of the year. The company showed a surplus of $1,861,704 after the payment of 5 per cent. dividends. This surplus, however, together with a portion of the working assets and the proceeds of a $1,000,000 bond issue, was spent for new property and for securities of other companies. The increase in these items for the year was $3,640,000. Discussing these figures already given by us, the *Wall Street Journal* says:

"The loss in net working assets of the company is a striking feature of the report. Comparison of quick assets for the last three years shows as follows:

	1904.	1903.	1902.
Current assets	$5,178,256	$5,332,392	$5,312,257
Current liabilities	4,238,690	3,696,244	2,843,744
Net assets	$939,566	$1,636,448	$2,468,513

"The loss in net assets in the two years was $1,528,947, or over 60 per cent. In this period the bonded debt increased $4,000,000, and the surplus over dividends was $4,130,426, making total resources spent $9,600,000. The increase in net earnings was less than $600,000 for the two years.

"In the competition of telephone and telegraph companies, the Western Union has fallen decidedly behind. In the last twenty years its gross earnings have increased about 50 per cent. The gross earnings of the Commercial Cable, including the Postal, have increased over 100 per cent., while the gross earnings of the Bell telephone companies have increased 850 per cent.

"The Western Union pays nearly $5,000,000 per annum in dividends, but its heavy capital charges, together with its slow growth, would seem to be operating toward a reduction in the dividend rate. Evidently, the company is now in a position where it must raise new capital."

Telephones on the Chicago, Burlington & Quincy.

Mr. W. W. Ryder, superintendent of telegraph, of the Chicago, Burlington & Quincy Railroad, states there is no foundation for the reports recently circulated in newspapers to the effect that the Burlington road had decided to substitute the telephone for the telegraph system in dispatching and operating trains. The Burlington has, Mr. Ryder says, made use of the telephone. On some

portions of the road it is used as a means of communication between block signal stations. Several stations west of Chicago are connected by telephone with Mr. Ryder's office. In other cases blind switches are connected with the nearest telegraph station by means of a telephone, thereby enabling the crew of a train lying on the siding to keep in touch with the telegraph station.

New Telephone Patents.

WIRE SUPPORT.

Messrs. C. F. Bettmann and John Zapp, of New Albany, Ind., have jointly invented a rather novel wire support. The support consists of a vertical shaft of metal, rotatively mounted in an insulating stand or bushing. Offset from the center line of rotation, the wire support proper is carried. This has the form of the familiar "split link," such as is used for repairing chains. It is, however, peculiar in shape, as the ends of the link are forged to a V and slightly twisted. As long as a line wire is taut in both directions, it merely rests in the V. Should it break and begin to pull through, the pull on the offset link rotates the whole support, causing the V to grip and hold the wire from falling beyond the broken section.

DESK STAND HOOK SWITCH.

A novel arrangement of springs for the hook switch of desk stand sets is set forth in Fig. 1, which is self-explanatory. The idea is a good one as far as making the springs accessible for inspection and repair goes. There is a question, however, as to whether this advantage may not be overcome by excessive maintenance due to the relatively short length of springs compared to the extent of their necessary motion. Klas Weman, of New York City, is the patentee of this device.

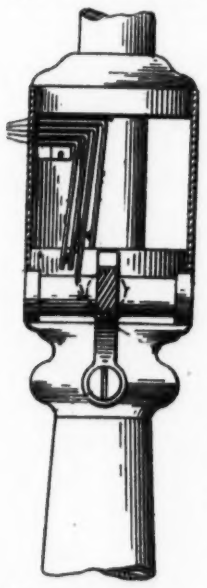


FIG. 1.—WEMAN HOOK SWITCH.

INTERCOMMUNICATING SWITCH.

An intercommunicating switch designed for use where a large number of lines are to be included in the system has been patented by Messrs. A. K. Andriano and H. Herbstritt, of San Francisco. It is readily understood that with thirty or more lines the ordinary push-button or dial switch becames bulky and the number of conductors to be cared for make it awkward. Because of this it has seemed advisable to the inventors, to divide the act of selecting a line into two parts. The first part consists of choosing a certain group of lines including the particular line desired. The second part is the selection of the desired line from its group.

An example will be of assistance in explaining the exact means employed. Suppose a system of thirty lines, divided into three groups of ten lines each. In the group switch these will end in thirty contacts arranged serially. Corresponding to each line contact is a movable contact, and all three of corresponding unit number, one in each group, will be connected together, thus: 3—13—23, on one

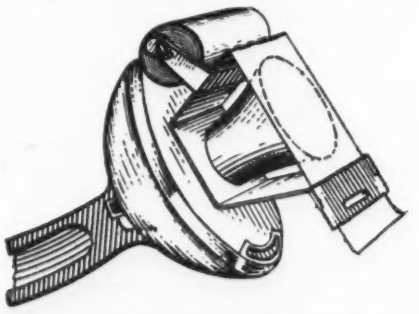


FIG. 2.—CUTTER HYGIENIC MOUTHPIECE.

circuit. All these multiple circuits, one for each unit of the group, are connected serially to a dial switch of as many points as there are units in the group, in this case ten. The last feature concerns the movable contacts. These are controllable in banks of ten. The first bank normally rests upon the line contacts of the first ten lines, but at will these may be moved clear of the lines and any other bank of ten connected to its lines. The act of selection consists then first in moving the group contacts to bring the desired line group to the dial switch and the setting of the dial arm to the units place of the desired line.

ANTISEPTIC DEVICE.

The sheet of paper antiseptic device has undergone further developments at the hands of H. L. Cutter, of Los Angeles. His invention relates chiefly to the design of the strip guide and means for tearing off used portions of the paper. A good idea of the appearance of such a hygienic device may be obtained from the accompanying cut.

Recent Electrochemical Developments.

NITRIC ACID FROM AIR.

It has long been recognized that the electric arc, in order to be effective in causting atmospheric nitrogen and oxygen to combine, must be subdivided into a great number of very thin arcs. Bradley and Lovejoy's device for accomplishing this by mechanically bringing the various sets of arc terminals in quick succession nearer together and removing them again periodically, is well known. In a patent granted October 18 to K. Birkeland the same result is produced by magnetically deflecting the arc. If a magnetic field is set up between the two poles of the arc the arc is deviated in a direction perpendicular to the magnetic lines of force, the resistance of the arc increases and the arc is broken, and simultaneously a new straight arc is formed between the electrodes and so on, so that there is quick succession of formation and interruption of arcs in form of a disc.

Some results obtained with this method in a somewhat large experimental plant in Sweden were noticed in the recent Congress paper of Edstrom, which was abstracted in our issue of September 24, page 525.

ELECTROMETALLURGY OF IRON AND STEEL.

When Stassano made his first experiments on the production of steel in the electric furnace he attempted to accomplish all the reactions—the reduction of the iron ore to metallic iron and the refining of iron to steel—in one and the same furnace. It is known that he has not been commercially successful. He is now reported to operate in a government plant in Turino a successful electric furnace for the production of steel, but his starting material is no longer iron ore, but scrap iron.

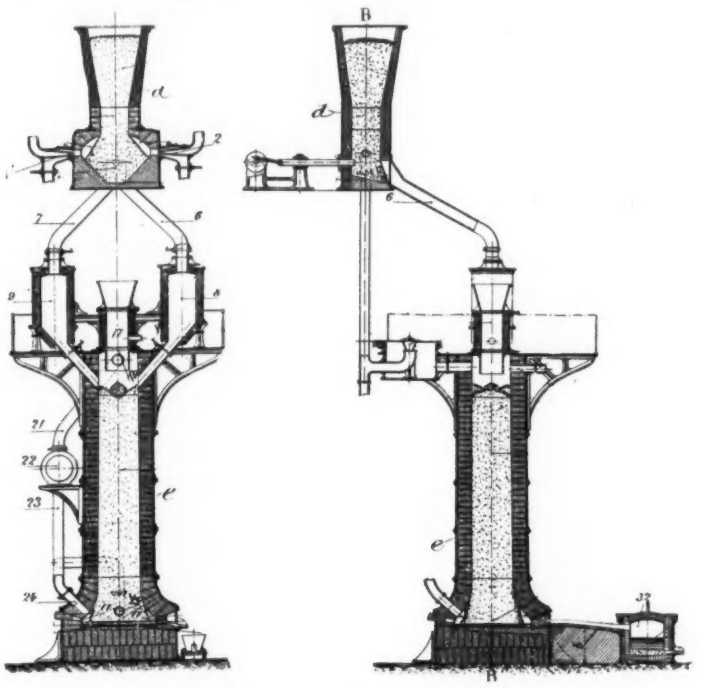
It has, in fact, been recognized by all who have worked in the electrometallurgy of iron and steel, that a furnace for reducing iron ore must be designed in a manner different from a refining furnace. Thus, when, for instance, Héroult and Keller produced steel from iron ore electrically it was done in two successive operations in separate and differently designed reduction and refining furnaces.

The same idea manifests itself in a patent, granted to H. Harmet, on October 18. His apparatus is shown in Fig. 1 giving two vertical sections, the left-hand diagram being a section on the line *B B* of the right-hand diagram. *d* at the top represents the calciner for the ore and fluxes, into which the raw materials, except the coke, are placed in successive charges, and are heated by hot gases introduced through the blowpipes, 2. At the sole of the calciner the ore is red hot and passes then down through 6 and 7 into the chargers 8 and 9, whence it is introduced into the reduction furnace, *e*. The reducing coke is charged through 17, where it is preheated. The mixture of ore and coke descends in the reduction furnace, *e*, and the oxide is reduced to metallic iron. At the bottom of *e* carbon electrodes are provided, whereby the metal is fused and is then introduced into the refining furnace, 32.

An important feature of the reduction process is to take gases from the mouth or top of the reduction furnace and force them into the fusion zone in contact with the incandescent carbon fuel; the gases are thereby converted into carbon monoxide and are then forced upward to act as a reducing agent upon the descending oxides. For this purpose pipes 21 and 23 and the blowing engine 22 are provided.

A patent granted to G. Gin on October 11 is for the construction of his steel furnace, which has already been noticed in these columns. It is essentially a resistance furnace, the charge forming the resistance and being arranged in a sinuous form comparable to the fila-

ment of an incandescent lamp on a large scale. The two terminals through which the electric current is introduced into the charge are large water-cooled steel blocks. The intention is, of course, to prevent any impurities from coming into the charge, so that the apparatus should be applicable for the manufacture of crucible steels.



ELECTRIC FURNACE FOR MAKING STEEL FROM IRON ORE.

It is not known whether the Harmet or the Gin process has been practically operated.

MISCELLANEOUS.

In mercury cathode apparatus for the electrolysis of sodium chloride, of which the Castner-Kellner cell is a typical and the most important example, it is of importance to provide a reliable method by which the mercury having become saturated with sodium in the electrolytic cell is removed from the latter and introduced into the de-amalgamating cell, where it gives off the sodium for the production of sodium hydroxide, to be returned again to the electrolytic cell. It is important to use such an arrangement that as little mercury as possible is required. Modifications of the Castner-Kellner apparatus have been proposed and tried by Rhodin at Sault Ste. Marie and by Bell at the Wyandotte works of the Pennsylvania Salt Company, without having so far achieved commercial success. A new mechanical arrangement for the same purpose was patented on October 11 by C. W. Roepper and W. E. Harmon. The main points of the patent are the arrangement of and the connections between the various compartments and the partitions between them.

A patent granted to W. R. King on October 11 refers to details of construction of a rotatable drum for containing articles to be electroplated.

A patent granted to F. Jackson on October 18 refers to a battery holder for batteries generating sparks on gasoline automobiles. The object is to provide for easy connection of the batteries to the spark-producing circuit.

A patent granted on October 11 to V. G. Apple refers to details of construction of a lead containing cell for secondary batteries.

Lewis and Clark Exposition.

As our readers are probably aware, a centennial Lewis and Clark Exposition is to be held at Portland, Ore., next year. One building is to contain the machinery, electricity and transportation exhibits. The allotment of space is to commence November 1, and the main office of the department of exhibits is in the Oregon State Building at the St. Louis Exposition. The average exhibit space in the Machinery Building is 18 ft. x 20 ft. No charge is made for exhibit space and freight is paid one way. Allotments of space are made directly by the Director of Exhibits rather than by the chief of the department, as at the St. Louis Exposition.

CURRENT NEWS AND NOTES.

REDUCTION IN RATE.—The Brooklyn Edison Company has just announced a reduction in the price of current, bringing its rates to a parity with those of the New York Edison Company. The old gross rate was 20 cents a kilowatt-hour. The new is 15 cents for one and two hours' average daily consumption; 10 cents for the third and fourth, 7½ cents for the fifth and sixth and 5 cents in excess of six hours. At 15 cents it figures out about ¾ cent per lamp-hour.

LIGHTS OUT IN LIMERICK.—The London *Electrician* notes the following incident at Limerick, Ireland: "The cause of a breakdown at the Limerick electricity works on Saturday was a very unusual and curious one. Limerick is a gas-driven station. On attempting to start the engines, the driver, who, it is said, was suffering from 'temporary incapacity,' omitted to close the electrical ignition circuit. Each engine is provided with a separate air compressor for starting purposes, and as a result of the driver's aberration these compressors became exhausted. They then had to be recharged by hand, this operation occupying 1½ hours."

AN EXPOSITION OF INFLATION.—A special telegram from St. Louis, Mo., of October 18 says: "The managers of the Louisiana Exposition Company have decided that it is not the material out of which the medals awarded to exhibitors are made that indicates their value, but the stamp of the Exposition Company. In other words, there will be no gold or silver medals at either the Philippine or Louisiana Expositions, though thousands have been awarded. All medals will be made of bronze. The only difference will be that those entitled to gold medals will find the word "Gold" stamped across the face of their bronze medals. The "silver" medals will be content with the base metal, with the word "Silver" stamped on them. This measure is taken because the Expositions are under heavy expense. Bids for the manufacture of these counterfeit gold and silver medals are now being called for." The better way would be to let each prize winner get his own gold medal done at his own expense in the real stuff. We believe that is the wise French method.

LETTER TO THE EDITORS.

Iron Towers in Wireless Telegraphy.

To the Editors of Electrical World and Engineer.

SIRS:—At a recent meeting at the Philadelphia local branch of the American Institute of Electrical Engineers, the question as to why wooden poles or towers were used in preference to iron ones was brought up in connection with iron or steel buildings acting as obstructions to the passage of electric waves. A satisfactory answer was not given and I venture to offer the following explanation:

That something happens, as was pointed out, when the waves strike an iron pole is certain; but this something is far from an absorption of the waves by the pole. Of course, the energy transmitted is decreased by passing through any kind of material, or we should be able to receive our own telegram sent around the earth. But it is a well-known fact that if there are no shunt circuits possible the waves are reflected by metals, like an echo, and even interfere with the transmitter at short distances, or they are deflected like rays of a light. I remember some experiments at a German university a few years ago where the waves were deflected by a metallic screen and received by a coherer near the sender, which could not be done when the screen was removed. To get a sound, when the screen was turned at a certain angle, the receiver had to be put up at another place according to the law of reflected rays. These experiments were made with some small apparatus of the early type. Thus it appears that waves can be sent in a determined direction, but it is not sure that they will be received in that direction.

As to an iron tower at the receiving station, let us assume that the energy comes from a direction behind the tower; that is, where no wires are attached. According to the dimensions of the tower, part of the energy there will be reflected and lost for transmission, while in the case of a wooden pole there would not be any obstacle. Now, let the waves come from the direction where the wires are spread toward the earth. Some waves propagating in a more vertical

plane will pass between the wires, strike the pole, become reflected and then come back to the receiving conductors.

I made a close inspection of the De Forest observation house on the hill behind "Jerusalem" at the St. Louis Exposition, where a wooden pole is used, and judging from the dimensions there it seems to me that it is very easily possible that the reflected wave lags 90° behind the wave just passing a single wire. Hence, we would have a complete interference, a stationary wave without any effect on the receiver. Other combinations are possible. For instance, a short impulse is less than 90° ahead of the reflected wave, which not only increases the intensity, but also adds to the duration of the impulse. Is it possible that in this way a dash will be produced by the Morse writer instead of a dot?

Though interested in, I am not engaged in, wireless telegraphy. I think, however, that it cannot be difficult to prove or reject my idea by placing a receiver between observation station and an iron tower with its face toward this tower.

PHILADELPHIA, PA. MAX FREIMARK.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Induction Motor.—LAMME.—A continuation of his illustrated paper on the polyphase induction motor. He first discusses motors for variable speed work, such as cranes, elevators, etc. He discusses the two chief methods of speed control, namely, by varying the secondary resistance and varying the applied e.m.f. His comparison shows that they give practically the same results in regard to starting, speed regulation, etc. But a motor that has been designed for regulation by varying its secondary resistance, will generally give poor results when an attempt is made to operate it by the variable e.m.f. method. A motor must be especially proportioned for small magnetic leakage when this method of control is to be used. The proportions and the arrangement of the parts are such as may class this as a practically distinct type of motor. The author then discusses the efficiency and power factor, describes the effects of lagging current and shows that the magnetizing current and magnetic leakage determine the power factor. A low magnetizing current is of great importance in maintaining a high power factor. If a high value of power factor over a wide range is desired, then both the leakage and magnetizing current must be low. The method of control by varying the primary e.m.f. is dependent upon the fact that the motor has a low magnetic leakage. By using certain proportions and arrangements of the windings on the primary secondary, the magnetizing current may be made comparatively low. Thus both conditions for good power factor are obtained. With the method of control by varying the secondary resistance, good power factors may be obtained. But the form of secondary winding required when variable resistances are used, tends to reduce both the power factor and the maximum torque. He discusses the best forms of secondary and primary windings and then passes over to motors for constant speed work, describing the features of the Westinghouse type C motor.—*Elec. Club Jour.*, October.

REFERENCES.

Design and Construction of Small Dynamos and Motors.—POOLE.—An illustrated article, the first of a series, the object of which is to enable one to build any size of direct-current motor or generator from 3 to 16 in. armature diameter without the necessity of mastering the science of dynamo design. The articles are limited to machines of conventional types and characteristics. It is stated that the reader need only follow instructions given to produce a machine which will operate sparklessly at normal loads with fixed brushes.—*Amer. Elec.*, October.

Regulation of Alternators.—KARAPETOFF.—In a continuation of his serial on applications of alternating-current diagrams, he discusses the regulation of alternators. He deals with the "equivalent self-induction" and armature reaction, and describes two methods for obtaining approximate load saturation curves, one being the armature reaction or the ampere-turn method, the other the self-induction or e.m.f. method. He then describes how to determine the drop and regulation of a machine from actual load tests.—*Elec. Club Jour.*, October.

Testing Alternating-Current Machinery.—KAULA.—The conclusion of his illustrated paper deals with tests of transformers and induction motors.—Lond. *Elec. Rev.*, October 7.

LIGHTS AND LIGHTING.

Blondel Arc Lamp.—An article on the Blondel arc lamp which has three peculiar features. First, only one of the carbons is impregnated with salts for increasing the illumination; secondly, the positive carbon is the lower one for direct-current arcs; thirdly, the upper arc is surrounded by a reflector. The impregnated lower carbon consists of three parts, a core and two concentric layers around it. The outside layer is pure carbon; the middle layer, which is the thickest one, is a mixture of carbon and salts for increasing the illumination (salts of calcium, magnesium, etc.), while the central core has the same composition but is less compressed. The object is that the arc should remain always in the center of the carbon and the carbon should burn off uniformly. The thickness of the carbon varies with the size of the lamps. For 5-amp. lamps the thickness is about 1.3 cm. and the length of the carbon decreases per hour about 1.3 cm. The upper carbon, which with direct current is the negative one, is mostly made of pure carbon and only very slightly impregnated. The vapors from the salts in the lower carbon rise into the arc and are heated to white heat, and are condensed on the reflector at the top of the lamp. The reflector consists of a central circular reflecting disc of insulating material and an external ring of metal. Lamps were first made for a supply current of 5 and 3 amp., but at present there are lamps which consume only 1 amp. The length of the arc is between 1.2 and 1.9 cm. and increases with the voltage. The normal voltage is 50. Different types of the Blondel lamp have been tested by Wedding, the results being given in the following tables and compared with the Bremer arc lamp:

	Volts.	Amperes.	Watts.	Hemispheric illumination in candles.	Watts per candle.
The lower carbon a positive Blondel-carbon of 9 mm. diameter, the upper a Siemens carbon A of 7 mm. diameter	57.4	2.99	171.5	1339	0.128
The same as before, but diameters of 11 and 7 mm. respectively	51.6	5.12	264.2	2210	0.109
The upper carbon a positive Siemens A carbon with core of 9 mm., the lower a negative Siemens carbon of 7 mm diameter	53.1	2.9	154.2	207	0.746
The same as before, but diameters of 11 and 9 mm. respectively	52.4	4.94	259.9	404	0.644
Bremer lamp	...	28.6	....	....	0.100
Bremer lamp	...	12.3	....	....	0.126

The Blondel lamp consumes only 9 per cent. more power per candle than the Bremer lamp, but this difference is thought to be of less importance since 0.1 watt per candle is obtained with the Bremer lamp only for such a high current as 20 amp., while the Blondel lamp gives about the same result for about 5 amp. The 3-amp. lamp is about as economical as the 12-amp. Bremer lamp.—*Zeit. f. Beleught*, September 30.

Impregnated Carbon for Arc Lamps.—CONRADTY.—The author states that it has been shown that in flame arcs the vapors of the acids contained in the metallic salts as well as the vapors of the heavy metals themselves are very poor conductors of electricity and poor illuminants. On the other hand, the vapors of alkali metals, alkaline earth metals and rare earth metals have a high conductivity, and the emission of light from these vapors is especially good if the loss of energy due to the evaporation of these substances and to the necessity of overcoming the high resistance of the long arc can be compensated by increasing the concentration of the gases and by increasing the temperature of the arc by internal chemical processes. These latter chemical processes the author proposes

to start by the introduction of free ozone. For this purpose the author uses a carbon tube, the mantle of which is impregnated with substances emitting light, such as alkalies, etc. In the center of the carbon tube there is a core containing the substances which are intended to give off oxygen; as such substances peróxide of sodium, calcium, barium may be used. The oxygen given off by the same is at once ozonized. When the ozone then comes in contact with the alkali carbon vapors, chemical changes are started which are stated to give a uniform increased temperature in the arc.—*Zeit. f. Beleught.*, September 10.

REFERENCE.

Decorative Lighting at the Louisiana Purchase Exposition.—Cravath.—An illustrated article on the Exposition lighting at St. Louis. The writer traces the evolution of the decorative lighting of expositions from the Columbian Exposition at Chicago to that at St. Louis. The distances from which the lighting is viewed at St. Louis rendered the problem difficult, and the inability to get a comprehensive view of the effects from one spot is pointed out. The various lighting details are described and the author concludes with descriptions of the electric signs used throughout the Exposition.—*Amer. Elec.*, October.

POWER.

Fuel Gas for Internal Combustion Engines.—Bibbins.—An illustrated article on the generation and uses of fuel gas. He discusses the requirements of an ideal power gas and reviews briefly the characteristics of several commercial power gases. He then compares the efficiencies of the various processes for generating power gas and points out the essential features of a good gas producer. Several types of producers are briefly described; they are distinguished into the three classes: continuous, intermittent and re-entrant. He finally gives some results obtained with gaseous fuel. He concludes that a well-equipped gas power generating plant should show a duty of at least one pound of coal per indicated hp-hour; many installations have shown much better under test.—*Cassier's Mag.*, October.

A Swiss Steam-Driven Turbine Plant.—An illustrated description of the central station at Neufchatel, Switzerland. After a careful consideration of the possibilities of gas engines as indicated by the results obtained in other plants, steam-driven units were installed. The station is designed for six boilers, four steam turbines, three 300-kw rotary converters and three 65-kw converters. The turbo-generators have a capacity of 300 kw each. The turbine speed is 3,000 r.p.m. under full load with 162 pounds steam pressure. The guaranteed steam consumption is 24.86 pounds per kw-hour at full load and 27¾ pounds at half load; steam being dry saturated at 162 pounds pressure, the temperature of the water of condensation not to exceed 20° C. The results of turbine tests made at Baden are given.—*Amer. Elec.*, October.

REFERENCE.

Gas Engines.—Arnold.—An illustrated description of a convenient equipment for shop-testing of gas engines and of the methods of testing.—*Elec. Club Jour.*, October.

TRACTION.

High-Speed Traction of Main Roads.—Borries.—The conclusion of his article, the first parts of which were recently abstracted in the Digest. He points out that an increase of speed of steam locomotives would not give the same result as high-speed electric railways in which the tendency is to run shorter trains at shorter intervals at greater speed. He thinks a train of three cars will be about right; each car should be a motor car. The front end of the train should be pointed and all side surfaces should be as plain as possible to decrease the air resistance. A three-car train would seat 100 passengers and could be provided with package rooms in the front and the back. If each car is a motor car, the weight of each car will be much less than with the high-speed cars now used on the experimental road. The train, with passengers, would weigh about 200 tons and with a speed of 96 miles it would require a tractive force of 1,260 kg. and a power of 750 hp. Each motor car would be supplied with two six-wheel trucks, each truck carrying one motor of 250 hp maximum capacity on its middle axle. He recommends the building of cars as light as possible. He thinks it is better to try for the present speed of 150 or 160 km. per hour than a higher one. He makes some critical remarks on a recent paper of Peters'. He thinks it wise not to build special roads for electric high-speed traction, but to run a number of electric high-speed trains on the present steam railroads.—*Elek. Bahnen.*, August, No. 16.

Overhead Equipment.—McElroy.—A paper presented to the British Municipal Tramways Association, giving a great many particulars of the overhead equipment and its maintenance in several important respects for most of the municipal tramway undertakings in the United Kingdom. The main point brought out is that there is a considerable diversity in construction and the author simply states the facts without giving his preference. Foremost comes the question of center-running versus side-running trolleys. Their relative advantages and disadvantages are stated. Some of the advocates of center-running trolleys claim as one of their advantages that less pressure may be used by the trolley wheels on the wire. In actual practice it is found that for side-running trolleys the pressure varies from 18 to 32 pounds and for center-running trolleys from 16 to 25 pounds, although many towns with side-running trolleys are running at less pressure than towns with center-running trolleys. The pressure, of course, considerably affects the wear and tear of the equipment. The size of the trolley wire adopted varies from 0 to 0000. Several towns have adopted or experimented with phono-electric wire (a hard bronze wire) which appears to have given good results, although it requires more careful handling during erection than copper wire, and has a higher resistance than copper wire. In Liverpool the life of 0 wire is about five years. In Glasgow the 00 wire has a life of three years with a service of 2½ cars per minute. In Leeds 0000 wire is used and on the oldest line, which has been in operation over seven years, and on portions of which there is a maximum service of 1½ minutes, the wear on the wire on the straight line is imperceptible. The wear on curves is very slight and will not necessitate renewal of the wire for considerable time yet. The paper is discussed in a long editorial.—Lond. *Elec.*, October 7.

Development of Railway Motor Design.—Dodd.—An historical article in which the writer first illustrates and describes the Brush railway motor of 1884, which was a series motor, but with open coils. The connection to the axle was by coiled steel wire belts instead of gearing. Daft in 1885 used the compound-wound, 125-volt motor, and Sprague in the same year a shunt-wound motor. Sprague introduced the flexible suspension and spur gearing. Motors in 1888 and 1889 were double reduction. Mailloux used a single reduction motor in 1889 and in 1891 two gearless motors were put on the market, but were not satisfactory. In 1893 the interchangeable armature coil was adopted. In 1896 laminated pole pieces were introduced, and in 1897 ventilated armatures. The writer then discusses the history of motor rating.—*St. R'y Jour.*, October 8.

REFERENCES.

Electric Freight Locomotives.—A description of the largest electric freight locomotive ever built in England and to be used on the electrified section of the North Eastern Railway, near Newcastle. Each of the locomotives when operating on a 600-volt circuit is capable of handling a train weighing 300 tons at over 14 miles per hour on a level. The locomotives are of the double-truck type, with central cab and sloping ends. The multiple-unit system of control will be used.—*St. R'y Jour.*, October 8.

Interurban Railroads.—R. Scott.—An article on high-speed electric interurban systems for freight and passengers, illustrated by some typical examples.—*Eng'ing Mag.*, October.

Single-Phase Traction.—Dooley.—A simple, non-mathematical, illustrater review of the most important features of the single-phase, alternating-current railway motor.—*Elec. Club Jour.*, October.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Starting and Regulating Resistance.—Lindenstruth and Forster.—An illustrated article describing various types of starting and regulating resistances using metallic wires. The authors emphasize the importance of reducing the size of large resistances to as small a volume as possible.—*L'Eclairage Elec.*, October 8.

WIRES, WIRING AND CONDUITS.

Effect of Continuous and Alternating Currents on the Dielectric Strength of Insulators.—Howe.—An account of experiments made by the Company of Electrical and Mechanical Industry, of Geneva (Thury system), intended to show the advantage of direct over

alternating current for long-distance power transmission, in so far as the insulation of the line and other particulars of the system is concerned. In tests of five different types of line insulators the breakdown voltage was found to be between 1.6 and 1.3 times higher for continuous voltage than for alternating voltage. In tests of 2 mm. marble with alternating-current breakdown occurred after 75 seconds under 20,000 volts, and after two minutes under 15,000 volts. With continuous current it broke down after 15 minutes, during which the pressure was raised from 10,000 to 45,000 volts, in steps of 5,000 volts every 2 minutes. These results are thought to be probably largely due to the absence of dielectric hysteresis when continuous current is employed. To prevent electrolytic destruction of the insulating materials, only such materials must be employed which are entirely free from water, like glass, porcelain, mica, etc. The highest voltage used at present on a direct-current transmission line (to Lausanne) is 22,000 volts. It is thought that in future much higher voltages could be employed for direct-current transmission and the figure 70,000 volts is mentioned. In an editorial note on the article it is said that the ratios 1.6 to 1.3 mentioned above are so near to the ratio between maximum and effective voltage that the writer cannot agree with the opinion expressed that the greater destructiveness of the alternating current is due to electric hysteresis. As a matter of fact, losses due to this cause are extremely small; according to some tests they are no more than 2.45 watts per insulator at 50,000 volts and 50 periods per second.—Lond. *Elec.*, October 7.

Electro-Physics and Magnetism.

Chemical Dissociation and Electrical Conductivity.—Garrett and Willows.—It has been found by Beattie and the authors that when various mixtures of substances were placed on the insulated plate of an air condenser and heated, a leakage of electricity took place. In a good many cases the rate of leak depends in a great measure on the sign of the charge given to the insulated plate. The authors endeavor to discover the origin of the leak, to find the seat of ionization and the nature of the ions. In one of Beattie's experiments an air condenser is formed of zinc plates; when iodine is placed in it no leak occurs beyond the small amount due to defective insulation of the supports, although the temperature is raised to 350°. All the iodine has long before this disappeared as vapor. Common salt alone in the condenser produces no effect when heated to the same temperature; but if the salt is sprinkled with iodine and placed on the insulated plate, then a large leak of positive electricity takes place when the temperature is raised. The present authors find that in this case the conduction observed is due to the formation of zinc iodide at the lower temperatures and a subsequent breaking up as the temperature rises. The sodium chloride appears to have a catalytic action during the formation. The authors have also made experiments with other substances. The source of the ions appears to be either the zinc or the oxygen of the air.—*Phil. Mag.*, October.

Forces Within the Molecule.—Martin.—A paper in which the author brings forward the view that chemically unstable compounds are, as a class, characterized by their volatility and fusibility; chemically stable compounds by their involatility and infusibility. For example, $SiCl_4$, BCl_3, $AlCl_3$, $SnCl_4$, etc., are all volatile and also easy to decompose, while the corresponding oxides are far less volatile and less easily decomposed. It is pointed out, further, that high valency compounds are usually more volatile than the corresponding compounds of lower valency; for instance, $SbCl_5$ is more volatile than $SbCl_3$. This behavior is regarded as due to the greater intensity of chemical forces in the lower valency compounds, as compared with the others. It seems, therefore, that it is the internal chemical forces which the atoms exert on each other in the molecule which decide the external attractive force with which the molecules themselves are attracted together, and, therefore, the volatility of the compound. The author believes that the chemical forces within the molecule determine also the solubility, fusibility, hardness, etc., of compounds, and that if these forces were known it might be possible to calculate mathematically the physical properties of chemical compounds.—*Chemical News*, Vol. LXXXIX, p. 241; from *Americal Jour. of Science*, October.

Electro-Chemistry and Batteries.

Electrolysis of Bromides of Alkalies.—Kretzschmar.—A long account of an experimental investigation in which he first studied the chemistry of the action of bromide upon alkalies and then applied his results to the explanation of the phenomena occurring during electrolysis of bromide solutions. Here free bromine is first evolved at the anode; it reacts with the free alkali coming from the cathode and yields hypobromide. The concentration of hypobromide reaches a constant value after some time and then bromate is formed. He investigated the difference in the behavior of polished and platinized platinum anodes.—*Zeit. f. Elektrochemie*, October 7.

Electrolysis of Potassium Acetate.—Foerster and Piguet.—An account of an experimental analysis of the various reactions which take place at the anode during electrolysis of potassium acetate, if anodes of different materials are used. There are three main reactions at the anode, i. e., the development of oxygen, the production of carbonic acid and the formation of ethane. By changing the material of the anode, it is possible to bring one or the other of these main reactions to the front.—*Zeit. f. Elektrochemie*, September 16.

Transport Number of Sulphuric Acid.—Tower.—A long account of a careful redetermination of the transport number of sulphuric acid. He finds that the most probable value of the mobility of the SO_4 ion is 70, which agrees with the figure of Kohlrausch.—*Jour. Am. Chem. Soc.*, September.

References.

Anodic Development of Oxygen.—Foerster and Piguet.—An account of an experimental investigation in which they studied the variation of the anodic potential required for continual development of oxygen during continuous electrolysis at insoluble anodes of different materials. The anodic potential generally increases with the time until it reaches a constant value. This is believed to be due to the fact that polished electrodes at which gas is developed are surrounded during electrolysis with a thin gas film.—*Zeit. f. Elektrochemie*, September 9.

Ionic Mobilities and Conductivity.—Kohlrausch and Grueneisen.—An account of conductivity measurements of electrolytes with a number of bivalent ions. They encountered considerable difficulty in deriving the conductivity from the ionic mobilities. The difficulty, which can be more or less surmounted when at least one of the ions is monovalent, becomes insuperable when both are bivalent. It appears that the solvent water must be taken into account.—*Sitz. Preuss. Alak. d. Wiss.*, July 28; abstracted in Lond. *Elec.*, September 30.

Electrolysis of Copper Sulphate.—Foerster and Coffetti.—An investigation showing that all anodic and cathodic phenomena in the electrolysis of copper sulphate can be completely explained if the equilibrium is taken into account, which always tends to be established between metallic copper, monovalent copper ions and bivalent copper ions. The authors applied their views to the explanation of some observations made in copper refining.—*Zeit. f. Elektrochemie*, September 16.

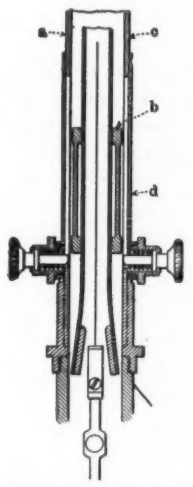
Sterilizing Milk.—Guarini.—A brief account of experiments in which milk was sterilized by alternating currents between carbon electrodes. The current must be strong enough and the treatment must be continued long enough to give perfect sterilization.—*Zeit. f. Elektrochemie*, September 2.

Units, Measurements and Instruments.

Induction Type of Voltmeter.—A note on correcting the induction type of voltmeter for changes of temperature. When the temperature of an induction type voltmeter having an aluminum disc revolving in the air-gap of an electromagnet increases, the resistance of the aluminum disc is increased, thereby decreasing the current flowing in the disc, which reduces the torque on the disc and consequently the deflection of the pointer; the current flowing in the magnetizing coil of the voltmeter is hardly affected by change of temperature since the impedance of the coil is mostly inductive; therefore, with increasing temperature, the current in the disc decreases, the current in the magnetizing coil remains constant and the readings of the instrument decrease. Two methods of correcting for change in temperature may be used, depending upon the frequency for which the instrument is designed. Both methods consist essentially in increasing the strength of field to compensate for the decreased current flowing in the aluminum disc. In meters for high frequencies, having a large torque, a short-circuited coil is placed completely around one pole of the electromagnet. Increasing temperature increases the resistance of this coil, which decreases the induced current flowing

in it, which in turn decreases the choking effect of the coil on the magnetic field. The field strength will, therefore, increase with increasing temperature, giving the compensation desired. In meters for low frequencies, a non-inductive resistance is shunted around the magnetizing coil of the voltmeter; and the size of wire and method of winding used in this shunt are such that its resistance increases with change of temperature at the same rate as the resistance of the aluminum disc. Therefore, with increasing temperature, more and more current flows through the magnetizing coil of the voltmeter, thus increasing the field strength and giving the desired compensation.—*Elec. Club Jour.*, October.

Protection of Suspension Fibres.—TOEPFER UND SOHN.—A description of an arrangement for the protection and safe transportation of silk and quartz fibres, which is illustrated herewith. The fibre is contained in a narrow brass tube, *a*, the lower end of which is split into strips, which spring out, and are provided with ivory cheeks. A muff, *b*, runs along the tube and is in turn surrounded by a second brass tube, *c*. An outer collar, *d*, bears two spring plugs which run in a groove cut along *c*, and can grip the muff, *b*, from above or below. When the thread is to be removed, *d* is raised until the plugs are above the muff. The plugs are then pressed in and down, whereupon the muff closes the cheeks and grips the carriage. The inner tube, *a*, can now be lifted out with absolute safety, and another thread can be substituted. The arrangement is chiefly intended for temporary observatories, where the mounting and testing of fibres is a lengthy and troublesome task.—*Zeit. f. Instrum.*, September; abstracted in Lond. *Elec.*, October 7.



PROTECTION OF SUSPENSION FIBRES.

Solenoid Cores.—PERO.—Some types of electromagnetic instruments cannot be used for exact measurements on account of the large remanant magnetism of their solenoid cores. It has been tried to overcome this disadvantage by using very light iron masses for the cores, but the reduction of the iron mass does not reduce the remanant magnetism; however, it eliminates the disturbing influence of eddy currents with the use of alternating currents. To eliminate the remanant magnetism the author states that the following requirements should be fulfilled: Soft iron must be used, the hysteresis loop of which is narrow, so that a small demagnetizing force is required for destroying the remanance. The solenoid cores must be light, so that they can be saturated even by weak currents, and so their magnetization is high. The magnetic axis of the solenoid core must be short, while the end cross-sections should be large.—*Zeit. f. Elek.* (Vienna), October 9.

REFERENCE.

Commercial Tests of Electric Machinery.—WORKMAN.—An illustrated article giving concise rules on tests of direct-current machines concerning polarity, iron loss and saturation, regulation, temperature and insulation. He then deals with commercial tests of small machines up to about 15 kw, commercial tests of series motors and describes the order of tests made on railway motors.—*Elec. Club Jour.*, October.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telephony.—MAJORANA.—A description of a system of wireless telephony for which he claims a transmitting power of several miles, though the actual distance hitherto traversed is only between the extreme ends of the Physical Institute of Rome. The principle is as follows: A succession of 10,000 sparks per second is produced by a Hertz oscillator. A means is found of lengthening or shortening the spark-gap, leaving the frequency unchanged. The lengthening and shortening is produced by the sound wave itself, which attacks one of the terminals of the spark-gap, whereas the other remains rigidly fixed. If the sparks are examined by means of a revolving mirror, they show a succession of lines which lengthen and shorten in a succession of waves corresponding to the sound waves. These waves are transmitted by the antennæ, and may be received by the magnetic or other detector. The steady succession of sparks at the rate of 10,000 per second does not interfere, as it produces a hissing note so high as to be practically inaudible. The author prefers to obtain the sparks from an induction coil of 40 cm. sparking length, operated from the mains at 40 periods per second. The frequency of the sparks increases as they continue, on account of the air being heated. They are, therefore, often more frequent than 10,000 per second, and can no longer be analyzed by the revolving mirror. Blowing air or carbonic acid across the gap serves to reduce the temperature to a steady state. But in order to obtain a constant pitch, the author introduces a magnetic fork. To reproduce the sounds of the microphone current, the author employs a jet of mercury as one terminal. This jet is set into the proper vibration and has the advantage of having no proper period of its own. The author refrains for the present from giving further details. Human speech is reproduced with as great a fidelity as it is by the phonograph or the telephone.—*Nuovo Cimento*, July; abstracted in Lond. *Elec.*, October 7.

MISCELLANEOUS.

Aluminum.—STRUTHERS.—An account of the production of aluminum and bauxite in 1903. The production of aluminum in the United States during 1903 is estimated at 7,500,000 pounds (against 7,300,000 in 1902, 4,000,000 in 1897, 1,300,000 in 1896, 61,281 in 1890 and 83 in 1883). Some notes are given on the Hall process used by the Pittsburg Reduction Company and on the capacity and equipment of works abroad which manufacture aluminum. The employment of aluminum for electric conductors instead of copper is still expanding and is one of the most important outlays for the domestic production. Ammonial is a new explosive composed of powdered aluminum and ammonium nitrate. The Goldschmidt thermit process is one of the most promising fields for the consumption of aluminum. A large proportion of the output of aluminum is manufactured into articles for domestic and culinary use and for the construction of machine parts which require lightness rather than great strength, and for many smaller purposes.—From a pamphlet of the *U. S. Geological Survey.*

REFERENCES.

Artificial Carbon.—ZELLNER.—A review of recent progress made in the manufacture of artificial amorphous carbons. After a general statistical outline, the manufacture of carbon brushes is briefly discussed, followed by a long summary of recent progress made in carbon for arc lamps, especially impregnated carbons.—*L'Eclairage Elec.*, October 8.

Electrical Law.—The first part of an article on electrical law in the British Colonies and India.—Lond. *Elec. Rev.*, September 30.

Special Steels.—Two extensive articles on special steels. One by Demozay deals with the classification of steels, another by Guillet, with the properties of vanadium steels.—*Revue de Met.*, October.

Important Developments in the Dynamo Electric Manufacturing Fields.

The National Electric Company, of Milwaukee, has entered into an important arrangement with Robert Lundell and Robert T. Lozier, by which the National Company will manufacture and market the new motors and generators, and systems of operation and control that are covered by the latest inventions of Robert Lundell; the commercial direction of the undertaking being placed in the hands of Mr. Lozier, who will also act as general manager of the electrical sales department of the National Company. Under this arrangement Mr. Lundell assumes the direct supervision of the engineering involved under the license that he grants the National Company covering all of Mr. Lundell's inventions not already under license to other companies, and all inventions that he may hereafter make during the life of this license.

These inventions of Mr. Lundell are of particular interest in that they cover important developments in direct-current apparatus. Some of the patents are for a new type of motor and dynamo frame construction, as well as a new method of commutation, by which a material gain is obtained in the space occupied by the apparatus, its efficiency and the flexibility of its speed control and regulation. This form of construction represents an important departure in standard motors of fixed speed, and is regarded as particularly advantageous in variable-speed motors for direct application to machinery, both from the point of construction and that of flexibility of control. These Lundell inventions are equally valuable in systems of regenerative operation and series parallel control and to the numerous uses to which electric motors are now so generally applied. The

whole group of patents are comprehensive in their scope. They cover a new type of machine construction, new principles of commutation and new methods of operation, based on Mr. Lundell's long and varied experience in the direct-current field, in which he has won distinction, his apparatus being now largely used, not only in this country, but throughout the other countries of the world. It may also be stated that the Johnson-Lundell Traction Company, of England, has been organized to manufacture under these patents in Great Britain and elsewhere abroad.

As to the commercial significance of this new arrangement, it is a field with which Mr. Lozier has been associated from the earliest commercial development of the electric motor, he having been in the testing department of the Sprague factory when it was started in West Thirtieth Street in 1887. He has since followed the development of the business in all its phases. It was in this shop that Mr. Lozier first met Mr. Lundell and formed a friendship that has developed into the alliance consummated by the arrangement with the National Company. In the 17 years that have followed each has had the opportunity of maturing experience in his own special line, and now their conjunction with the National Company's splendid manufacturing facilities and high commercial standing completes an episode of considerable importance to the trade and to the art.

The National Electric Company, of Milwaukee, formerly operating under the style "Christensen Engineering Company," has in the past seven years equipped the majority of the electric cars using air brakes. Four years ago they built their present plant, abundantly equipped it with the best tools and labor-saving machinery. The foundry has open hearth and crucible furnaces for making steel castings; also cupolas for gray cast iron, and a complete brass foundry as well. The plant has all the other features necessary to make it one of the most comprehensive and up-to-date plants to be found in the electrical manufacturing business. The success met with in the air brake business encouraged those financially back of the National Company to enter into the general field of electrical machinery, and two years ago a competent engineering corps under the able direction of Mr. W. L. Waters, chief engineer of the National Electric Company, and an active sales organization was put into operation. The results of this work have in turn been so thoroughly successful that the National Company has now decided to follow up the material gain already made, with a view to developing this branch of its business to its fullest capacity, and to this end has established a separate electrical department. Mr. Lozier will be aided in directing the work of that department by his long experience in the electrical field, beginning with Edison early in 1883 and running down through the engineering and commercial branches of the business for 13 years, with the General Electric Company, for the last eight years having devoted his time to marketing the apparatus of the Bullock Electric Manufacturing Company.

Mr. Samuel Watkins is the president of the National Company. He organized it, and under his able direction the company has reached its present prominence. Mr. Bernard T. Becker, who represents the interests of those financially back of the company, and who is himself a large stockholder and a director in the company, will act in an executive capacity in connection with the operation of the company. Of the operative force, Mr. R. P. Tell is the secretary and treasurer. Mr. J. H. Denton, well known to all those who come in contact with the air brake business, is general superintendent.

The first vice-president and general manager of the National Electric Company, Mr. Frank C. Randall, is widely known throughout the electric street railway field and the air brake sales will continue as in the past, under his direct charge.

Telpherage Plant for Handling Sand.

The development of the trolley in handling passengers seems destined at no very distant date to be equaled in many respects by that of the telpher in hauling material. An exemplification of this fact and of the growing field of utility of telpherage is found in the interesting plant that is herewith illustrated, viz.: that of the Knickerbocker Lime Company, at Philadelphia, Pa. In this plant it is necessary to handle a large amount of material quickly, as well as to transport it from the water's edge and dump it into large bins in a long building. These bins are on the ground floor and the telpherage line is in the upper story. Fig. 1 herewith shows the intervening track with a steel tower 90 ft. high, a projecting steel boom extending 50 ft. from the tower and 50 ft. above the river, and a grab bucket with a capacity of 40 cu. ft. Electricity with the aid of one main raises, conveys, dumps and turns the switch, in the place of a former narrow-gauge railway. The distance of haulage is 700 ft. The enclosed cab is for the telpherman.

The steel boom carries the track for the telpher and the double drum hoist which operates the clamshell bucket, so that the same may be run out over the river, and thus cover the whole width of one or more scows. The telpher with its hoist and clamshell bucket it run out on the boom over the scow and the sand or other material picked up by a grab bucket operated by a double drum electric hoist of the latest special design by the United Telpherage Company, of New York. This clamshell bucket holding 1½ cubic yards of wet sand, weighing about two tons, is then hoisted rapidly up about 40 ft. The telpher is run back and the sand deposited in a hopper which is located in the center of the tower. The telpher is then run out over the scow and the bucket lowered ready to pick up another load. This sand or other material is picked up, hoisted, conveyed and deposited in the hopper by the one man in the cab of the telpher. This cab is enclosed against the weather, together with the hoisting machinery, and the man is able to see exactly where the sand is in

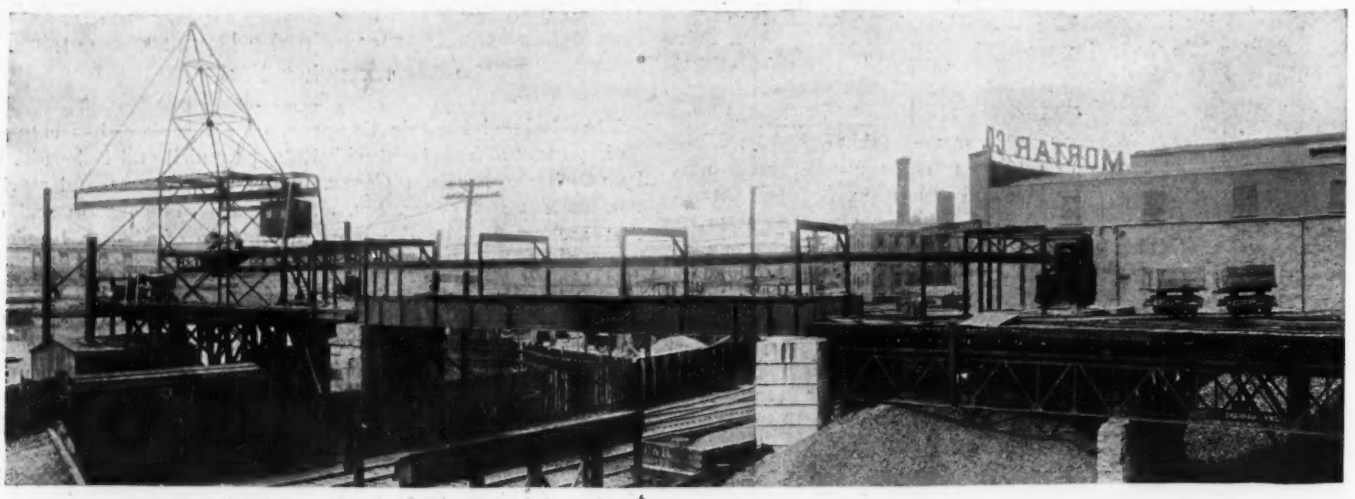


FIG. 1.—TELPHERAGE PLANT AT PHILADELPHIA.

the barge and also to deposit it in the hopper without the necessity of any signalman. From the hopper another steel track, supported by steel bents, extends back and runs along a trestle, crosses the Baltimore & Ohio Railroad track on a steel bridge, runs across another trestle, and enters the storage house, through which it passes to the different bins. The load is dumped to the right or left by means of levers operated by the telpherman.

Another telpher carrying a steel car of over 2½ cubic yards capacity is run on the track under the hopper and the bucket filled

in a few seconds through a door in the bucket of the hopper. The operator then runs this telpher with its car full of sand into the storage house, deposits his load in the proper bins and returns for another load. On account of the distance to which this sand had to be carried from the hopper, the car was made double the capacity of the grab bucket, so that it would only have to make one trip to every two of the grab bucket. The whole construction of above machines, buckets, track and supports is of steel throughout. The old method of unloading the scows was to shovel the sand into

FIG. 2.—TELPHERAGE PLANT.

small buckets and hoist same with a stationary steam hoist, dump the bucket into cars and then push the cars on the trestle and into the storage house. There was required four men to shovel sand from the scow into the bucket, one engineer and a signal man for hoisting the buckets and one man to dump buckets into cars, and four men to push the cars by hand, making a total of 11 men.

Telpherage requires but one man to fill buckets and hoist them and one man for a portion of the time to clean up the scows in the corners, and one man to operate the telpher from hopper to bins, or a total of two men all the time and one additional man part of the time. In addition to the above, very much more sand is conveyed in a given time than formerly, so that the cost for labor is much less than one-tenth of what it was formerly.

Crane Equipment of the Missouri River Power Station, Kansas City, Mo.

The Metropolitan Street Railway Company, of Kansas City, has in its new Missouri River Power Station one of the most recent additions to the large central stations of this country. A preliminary description of it has already appeared in ELECTRICAL WORLD AND ENGINEER. The erection of this station represents a consolidation of traction, power and lighting interests in Kansas City. As a means to both convenience and economy nearly all the current in the city will be generated in this building, when all the machinery is in place. It will have an ultimate capacity of 40,000 kw, of which some 15,000 kw is now effective and will generate current of 6,600 volts to be distributed by underground conduits to six sub-stations and there transformed to suitable voltages for traction, power and lighting. Erection of the building began late in 1902 and, to permit installing the engines and generators as they arrived, an electric traveling crane was ordered for delivery in April, 1903. This is a four-motor crane, built by Pawling & Harnischfeger, Milwaukee, Wis., and is the subject of the illustration herewith.

The building is of skeleton frame, equipped with a gallery all around, and the inner columns for this gallery also support the crane runways. The total length of this runway is 248 ft. 4 in. and carries a rail weighing 100 pounds to the yard. The span of the crane bridge is 70 ft. 5 in. and the bridge is of riveted box section. The hoisting mechanism is contained in what the manufacturers term their "Type A" trolley. The main hoist is of 60 tons capacity and equipped with an auxiliary hoist of 10 tons capacity. Each motion is protected by a load brake, motor brake and limit switch. The main hoist has a total lift of 58 ft., using ten parts of 1-in. wire rope of a total length of 662 ft. The auxiliary hoist provides a lift of 66 ft. and comprises four parts of ⅝-in. wire rope having a total length of 344 ft. The trolley traverses the entire length of the bridge and the current for this travel, as well as for the hoisting movements, is conveyed by ten trolley wires placed between the bridge girders.

MISSOURI RIVER POWER STATION, KANSAS CITY.

The motors and speeds for the entire crane are as follows:

	Main hoist.	Aux. hoist.	Trolley trav.	Bridge trav.
Motors	60-H.P.	20-H.P.	15-H.P.	30-H.P.
Speeds per minute full load and light	10-25 ft.	20-60 ft.	100-150 ft.	200-250 ft.

The bridge travel is effected by a motor attached to the front of the girder and operates a cross shaft, which actuates one truck wheel at each end of the crane. A cage for the operator contains the four

controllers and all the necessary electrical equipment. The potential is 500 volts direct current. The approximate shipping weight of the crane was 155,000 pounds.

The view shows but three of the Allis-Chalmers vertical cross-compound engines, each of 4,600 hp, direct-connected to General Electric generators. A considerable portion of the remainder of the power equipment has been installed within the last few weeks. Pawling & Harnischfeger likewise furnished two 10-ton chain block traveling cranes of 55 ft. 4 in. span for service in this engine room.

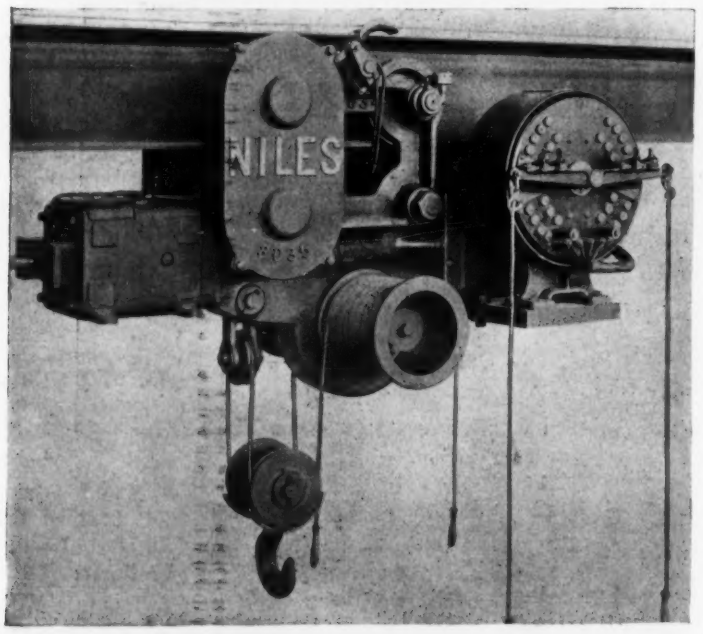
A Drafting Room Competition.

The Electric Controller & Supply Company, of Cleveland, posted a notice in its drafting room recently to the effect that it was its intention to relieve Mr. Pirtle, who has been in charge of its exhibit at the Louisiana Purchase Exposition since the opening of the Fair. As a means of selecting the man best suited for this work, it decided to inaugurate a contest among its draftsmen, allowing all to enter. The contest consisted of two written articles—one on the company's improved direct motor drive for planers and the other on its mill table controller. All articles presented to be judged from the following standpoints: First, the clearest description of the functions and operation of the various switches, circuits, etc., from an engineering standpoint, to count 40 points. Second, the best statement of the advantages arising from the use of the apparatus viewed from the standpoint of the customer, to count 30 points. Third, the best composition from the standpoint of rhetoric and grammar, to count 30 points. All work on these articles to be done outside of office hours.

The four judges consisted of A. C. Eastwood, engineer; R. I. Wright, assistant engineer; Harold McGeorge, general manager, and J. H. Hall, chief draftsman. Competition was keen and a number of interesting papers were presented, requiring long and careful deliberation on the part of the judges. A decision was rendered in favor of Mr. George W. Magalhaes, who was formerly a student of Case School of Applied Science and later a graduate of Columbia University. Mr. Magalhaes will start for St. Louis within a few days and remain in charge of the company's exhibit until the close of the Fair.

Electric Traveling Hoists.

Electric traveling hoists are rapidly coming into favor and many of the more progressive shops are installing them in place of hand hoists. Besides the direct advantage of handling loads vastly quicker than the hand hoist, the electric traveling hoist has the indirect advantage of increasing the output of a shop by waking up the men. The hoist moves so rapidly that it compels the workmen to be quick in their movements, and instinctively they do their regular work more quickly. On the other hand, if the workman is using a hand hoist, he is pretty well tired out after he has lifted a load and does not return to his regular work with much vigor.



ELECTRIC TRAVELING HOIST.

The illustration shows a new type of Niles hoist built in capacities of ¾ to 6 tons and may be used either as hoists, in which case they run on an I-beam track, or when mounted on a traveling bridge they may be used for small capacity cranes. In the latter case they are arranged to run between the two I-beams or channels of the bridge, and the controllers for raising and lowering the hook and operating the traversing mechanism may be placed either on the hoist, on the bridge and operated by cords from the floor, or in an operator's cage attached to the bridge.

When used on an I-beam the controllers are attached to the hoist and operated by cords from the floor. These hoists will run on straight and curved tracks and are usually provided with a separate motor for traversing, but if desired, hand traverse may be furnished, or all the traversing mechanism may be omitted and the trolley moved along the track by pushing on the load. The increased service of the electric traverse, however, much more than compensates for the slight additional cost.

The hoist is self-contained in one heavy cast-iron frame to which the motors are attached end on, and the power is transmitted directly from the armature shaft to the drum shaft through one train of worm and worm wheel gears. The traversing mechanism is also driven through one train of worm and worm wheel gears similar to the hoisting mechanism, except that when the trolley is arranged to run on a single I-beam, a double set of transmission gears is used to connect the worm gear shaft to the truck wheel shafts.

In addition to the braking effect obtained by the use of the worm and worm wheel, a powerful electric brake is attached to the hoist motor. These hoists are built by Niles-Bement-Pond Company, New York.

A Novel Telephone Exhibit.

Pittsburg has an annual exposition which is always well patronized. The exhibits are of the highest quality and the large companies of the city expend liberal amounts of talent and money to make them attractive. Among the exhibits this year the local Bell Telephone Company has something that is very attractive. A large room decorated in green and white is equipped with a private branch switchboard in operation. To this board are connected all the exhibitors' telephones, besides the pay station booths throughout the exposition.

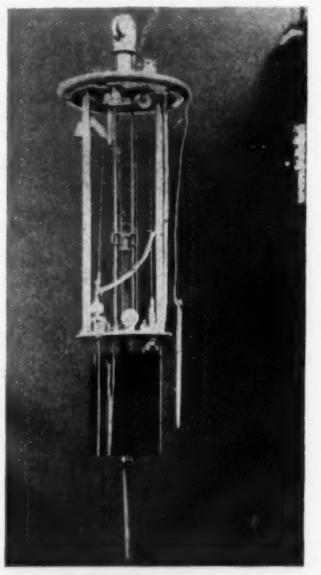


FIG. I.—SPEAKING ARC LAMP.

In addition is shown telephone apparatus of the most modern type, including central energy subscribers' sets, suburban railway, mining and railway composite sets, street pay stations, telegraph instruments, extension bells and a cordless switchboard.

The novel features of the exhibit are an "Arcophone" or "Speaking Arc Lamp," a "Wireless Telephone" and the reproduction of a play at the Nixon Theatre.

The "Arcophone" reproduces through the flame of the arc all sounds such as words, music and whistling from a transmitter located in a distant part of the building.

The "burning" words, as they may well be called, are very clear and distinct. Part of the time the arc is made to emit music and amuse the people, and at other times to tell the good qualities of the Bell service.

Another weird and puzzling feature is the "Wireless Telephone" or "Noisy Noiseless Court," where visitors by placing crowns upon their heads are enabled to hear the Damrosch Orchestra which is playing in a distant part of the exposition grounds. This device is illustrated in Fig. 2 on the next page.

The arrangement of this apparatus is simple and consists of a powerful transmitter suspended from the ceiling of the auditorium, the mouthpiece of which was replaced by a large morning glory phonograph horn. In circuit with this transmitter is a large primary coil and battery located in the roof of the telephone company's exhibit. This coil induces currents of electricity in a secondary coil concealed within the rim of the crown and connected with two receivers.

The idea of being able to hear sounds, otherwise inaudible, is mystifying and appears wonderful to the listener. They examine

FIG. 2.—WIRELESS TELEPHONE.

the crowns to see if there is not some invisible wire connection to the sides of the room or ceiling or possibly a very small phonograph concealed in some part of the crown. The music heard through the crowns is very loud and of good quality.

Another feature which deserves mention is that of the reproduction of the words and music transmitted direct from a play at the Nixon Theatre. This is accomplished by placing receivers about the

FIG. 3.—BELL TELEPHONE COMPANY'S EXHIBIT.

exhibit, which are connected through the telephone company's underground cable system, with transmitters arranged upon the stage of the theatre.

The company also allows the free use of its lines to the public for one hour each day, giving free toll service to any point within a hundred miles of Pittsburg.

The exhibit was designed and arranged under the personal direction of Mr. S. P. Grace, chief engineer of the local Bell company, with Mr. R. A. L. Snyder in charge of the electrical novelties and Mr. J. B. Reddig of the switchboard apparatus.

A Group of St. Louis Electrical Exhibits.

General attention is attracted in the Palace of Transportation to a large 162-ton "Big Four" locomotive running at a high speed on a turntable, the turntable itself revolving on its axle. Four railway signals are placed around the railing of this exhibit, automatically opening and closing the way as soon as the head of the locomotive approaches them. The electric equipment and wiring of this exhibit was furnished by the Westinghouse Companies, two Westinghouse motors driving the engine and the turntable and one motor drives a small special dynamo on the locomotive itself, which supplies the headlight with electric current. The engine is equipped with a Westinghouse high-speed air brake set; the signals are those of the Union Signal & Switch Company, and are supplied with compressed air from the Westinghouse air brake exhibit in the Palace of Transportation. The motor for revolving the turntable is a 15-hp, 220-volt railway type crane motor placed inside of the turntable and transmits its motion through double gears to a pinion, which runs on a circular rack provided on the bedplate of the turntable. Current to this motor, as well as to two other motors, is led through two slip rings and brushes fastened on the turntable. The motor operating the drivers of the locomotive is an 18-hp, 220-volt, 355-r.p.m., semi-enclosed shunt motor. It is also placed inside of the turntable and connected to the drivers through beveled gears and a friction gear. A

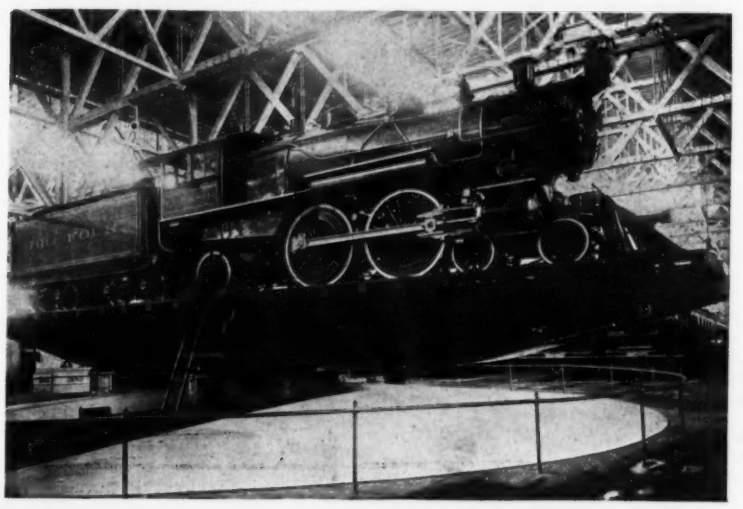


FIG. 1.—ELECTRIC SIGNAL AND TURNTABLE.

rheostat and a controller for operating these motors are placed on the turntable near the steps to the engineer's cab.

The headlight dynamo is driven by a Westinghouse 3-hp, 220-volt, 1,800-r.p.m. shunt motor, provided with a starting and stopping box. The signals are of the automatic type, in which the engine closes the rail circuit by its own wheels. This circuit operates a relay placed in the base of the signal, which in its turn actuates the mechanism, raising up the blade in "danger" position. Four signals are exhibited. In one the blade is operated by compressed air through an electro-pneumatic valve admitting air into a cylinder; in another the same is done by compressed liquid carbonic acid, which is more easily stored than air, and two other signals are purely electrical, the blade being operated by a small enclosed electric motor receiving its current from a local primary or storage battery situated in the base of the signal pole or underground. The turntable with its motor has been designed so as to be used by the "Big Four" Railroad in actual operation after the Fair is over.

Processes through which raw materials are converted into finished products are emphasized throughout all of the exhibits at the Fair. However, in the booth of the American School of Correspondence is shown the wonderfully successful modern method by which men, who cannot go to college, are developed into a higher and a better grade of scholarship and equipped to cope with the problems of engineering. In this booth are exhibited the results of some six or eight years of teaching along the lines of engineering. The students' work includes various patterns, tool work and drawings, notable among the latter being several architectural elevations by W. H. Krausch, chief architect for the Chicago, Burlington & Quincy Railroad Company, and two large prints by B. A. Slocum, of the Boston Machine Works. A large map facing the entrance shows the geographical

distribution of students throughout the world, and bears witness to the great scope and far-reaching influence of the school. An automatic telegraph instrument, by means of which the subject of telegraphy is taught, is in constant operation, and a Kellogg switchboard, illustrating telephone practice, is also installed. This switchboard operates with the apparatus of the Controller Company of America and has for its purpose the illustration of various trunking systems. The public is not fully informed of the inside workings of correspondence schools, although these have been brought strongly to the attention of people at home and abroad within the last few months.

FIG. 2.—BOOTH OF AMERICAN SCHOOL OF CORRESPONDENCE.

A display of textbooks written by the best authors shows the way in which the work is prepared and gives the visitor a good idea of the steps by which students are led from the simplest of mathematics to higher and more complex electrical engineering problems.

In the northeast corner of the Machinery Building the Ashton Valve Company has an exhibit of its steam specialties, which include gauges, whistles and valves of all kinds. A pocket test gauge will draw the attention of chief engineers, master mechanics and inspectors. This gauge is three inches in diameter, weighs about a pound and is made for carrying in the pocket. A muffler attachment for safety valves is designed for muffling the noise of escaping steam without causing a dangerous back pressure. This is especially serviceable in isolated plants of office buildings, hospitals and in other crowded portions of the city. Ashton blow-off valves, special steam heating pop safety valve for automatic relief on heating mains for pressures less than thirty pounds and lock-up pop safety valves for stationary and marine boilers are among the specialties exhibited.

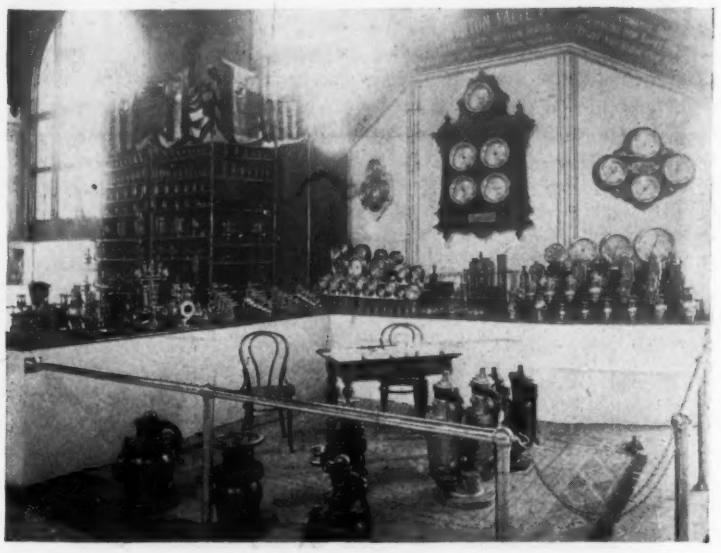


FIG. 3.—EXHIBIT OF THE ASHTON VALVE COMPANY.

The exhibit of the Wesco Supply Company, occupying all of Block No. 8 in the Palace of Electricity, is comprised of the displays of twenty prominent electrical manufacturers, including nearly every railway, lighting, power and telephone apparatus. In the center of the space is a booth and private office fitted with telephones, fans and other conveniences which tend to complete the furnishings of a modern establishment. The product of the Wesco Company itself includes the "Wesco" and "Red Shield" dry batteries and various

FIG. 4.—EXHIBIT OF THE WESCO SUPPLY COMPANY.

styles of series and bridging telephones, one of the latter being so constructed that the practical working parts may be seen without opening the telephone box. The whole telephone system is connected and operated by a 50-drop switchboard located in front of the office. Several Adams secondary generators are installed on the secondary of the alternating-current circuit, showing the practicability of this substitute for batteries, which can be used successfully for the operation of annunciators, bells and similar work.

The Phelps Company is exhibiting the Hylo turn-down lamps, made in three different styles, turn-bulb, pull-string and long-distance. In the turn-bulb the light is reduced from a 16-cp by turning the bulb, which was the first Hylo produced, and more than a million are now being used. The pull-string Hylo is provided with strings 13 in. long, which turn the light up and down or entirely out. Where the socket is too high to be easily reached the pull-string Hylo is very convenient and wall switches are not needed. The switching mechanism is contained in the base of the lamp and only the strings are visible. This adds to the neat appearance and protects the switch from external injury, complying also with underwriters' requirements. The long-distance Hylo consists of a lamp, a cord and a switch. The cord may be any length desired and by means of a neat little switch the lamp can be turned up, down or out. These turn-down lamps are shown in a darkened Turkish room, where the subdued light of the baby filaments produce a very pretty effect. They are shown connected with sensitive Stanley and Fort Wayne instruments; by turning the lamp up and down the disc goes fast or slow. The claim for the Hylo lamp is that it saves 5/6 of

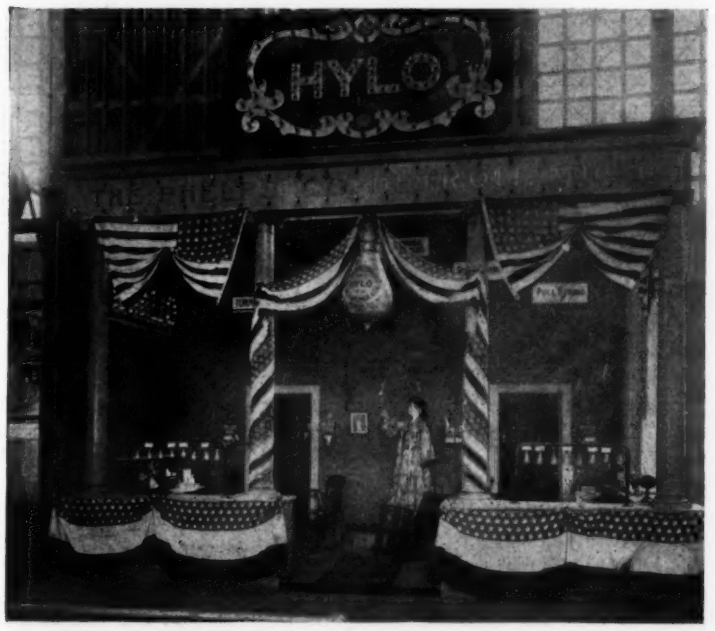


FIG. 5.—HYLO LAMP EXHIBIT.

the current when turned down and will burn as long as three standard lamps. The Phelps Company also manufactures some very interesting sign specialties, the self-flashing sign lamp and the "Skedoodle" socket plugs. The self-flashing sign lamps are of the regular Hylo type, with big and baby filaments. Inside an ordinary Edison base there is concealed a mechanism which turns the light up and down from the big to the baby filament at regular intervals. This mechanism consists in the expansion and contraction of two dissimilar metals caused by heating or cooling as the lamp is high or low. Heavy platinum contacts are used and the lamp is guaranteed to save 50 per cent. of the current and operate for 2,000 hours. The "Skedoodle" socket is a socket plug having the same mechanism as the self-flashing lamp, and designed to flash any standard lamp off and on about 15 times per minute.

A number of signs of different manufacture are exhibited in a dark room showing the practical use of these lamps. A big four-foot transparent Hylo bulb made by the Southern Illuminated Sign Company makes a very striking illustration of the effect of self-flashing lamps in an illuminated type of sign. A very beautiful decorative effect is produced by several self-flashing lamps of different colors in a Holophane globe. This produces continuous change of color in a great variety of combinations. The self-flashing lamps are shown in a large lettered sign, the distinct advantage lying in the fact that the sign never goes out entirely as the baby filament holds the shape of the letter. At a little distance this kind of a sign has a very pretty twinkling star effect. A large sign of this kind may be seen at the main entrance of the Fair grounds reading "Frisco-Rock Island." Self-flashing lamps and "Skedoodle" socket plugs supply movement and life without mechanism, at very small expense and under a great variety of conditions.

Porcelain enameled steel electric signs are exhibited by the Federal Electric Company, opposite the General Electric Company's display. Electric signs of themselves are not particularly new, they having been manufactured for years of wood, tin, etc., but the electric sign as an accessory of the central station for helping to pad out the load curve peak, and at the same time to remain a source of considerable profit to the station, is rather recent. The signs of the Federal Electric Company are of two classes, panel signs and sectional letter signs. The panel signs are constructed in such a manner that the panels may be easily slipped out, without disturbing the frame or its fastenings. This feature has many advantages, the chief being that the user may advertise as he wishes from time to time. Of late many central station companies have taken up the plan of putting these signs out free of cost to the user, the latter agreeing to pay a reasonable rate for the service, including the rental of the sign and the cost of lighting, the company renewing the lamps, keeping the sign clean, and switching it. This plan has many good features; the station, when enough signs have been put on its mains, arranges its switching so that the sign load comes on shortly after the peak, thus tending to broaden an otherwise bad curve; the customer gets a class of advertising so low in price compared to what he would expend in ordinary newspaper or circular publicity, that it is a source of easy and good profit to him; and the city in which they are used derives the added benefit of brightly lighted streets.

FIG. 6.—FEDERAL ELECTRIC COMPANY'S EXHIBIT.

The panel sign is constructed as follows: The frame is made of heavy galvanized sheet iron enameled with three coats of the best grade of white bicycle enamel. The sockets are set in the border; the panels are made of steel, porcelain enameled, usually with white letters on a royal blue background. The hanging rig consists of gaspipe crane, chains, turnbuckles, wall fittings, etc., all of which are galvanized in a thorough manner to provide against any formation of rust. These signs are made in a variety of standard sizes and designs with from twelve to thirty-two lights on each side.

The "sectional letter" signs are new and novel. Each letter in the alphabet is enameled on a separate steel plate, the raised portion,

on which the letter is enameled, being drawn out so as to raise it about two inches above the remaining surface of the sign. The standard color signs have letters of white on a background of royal blue. Here again the use of porcelain enamel gives a finish unequaled for durability and reflecting qualities, and the plates are enameled both inside and out to preclude any possibility of rust. These plates, when ready to be built into a sign are first wired, then screwed to a galvanized channel iron frame with brass machine screws. When finished they present a most pleasing appearance, and at the same time fulfill the most exacting demands as to stiffness of construction, durability and safety from fire and water. Having each letter on a separate plate makes it a comparatively easy and inexpensive operation to construct new signs from old, as in most cases the frames can be used again, and the letters always.

The William Powell Company has an exhibit of brass and iron steam engineering appliances in the northeast corner of the Machinery Building. Attention is drawn to the booth by an electrical flashboard upon which is a representation of the company's factory in Cincinnati. The board is 30 in. x 66 in., of seasoned pine, ½-in. stock, upon which is a sheet of tinfoil 24 in. x 60 in., cut into blocks ¼ in. square. The building picture is of sheet asbestos 1/32 in. thick. The current jumping rapidly across the cut places in the tinfoil sheet attracts notice by the noise and flashing made. A Western Electric motor-generator supplies a current of 9 amp. and 25 volts to the primary of an induction coil, the secondary of which is connected to the tinfoil.

In the Wesco space the Gardner Electric Drill & Machinery Company has installed and in operation a mining drill which is now being extensively used in place of air drills. The general appearance is the same as an air drill and the method of setting up and operating it is also similar. The drill is actuated by a flexible shaft, which connects it to the motor and imparts the motion, through mitre gears and the crankshaft, to a drawbar and piston, which is cushioned with helical springs and serves the double purpose of absorbing the shock of the blow and protecting the parts from injury, also for storing up energy on the back stroke, which is expended when the steel is striking rock. The flexible shaft is so made that it can be detached instantly when necessary to move the apparatus for blasting. It allows the drill to be shifted to any position without moving the motor and makes it as easily handled in sinking as it is in stopping

FIG. 7.—EXHIBIT OF GARDNER ELECTRIC DRILL & MFG. CO.

or breast work. The connection between the crank and drawbar is ingeniously arranged to give a quick forward stroke, adding to the force of the blow, and slow return that serves as a protection when working in seamy ground where there is danger of sticking. The current consumption for drilling is from one to two hp. The source of energy may be either from an existing power circuit or from a small isolated steam or gasoline plant.

The Moloney Electric Company makes a specialty of transformers of smaller sizes for alternating-current light and power service. In the Wesco exhibit these transformers from ½ to 25 kw capacity are shown. A transformer is dismantled to display the thorough insulation, ventilation and careful workmanship.

The Warren Electric Manufacturing Company has its alternators on exhibition in two places—one in Machinery Hall, where an engine-driven unit supplies current for arc lamps, and another in the Palace of Electricity, furnishing current to operate the apparatus in the space of the Wesco Company. This latter machine has been converted into a motor taking current from the Warren alternator in the Machinery Hall and driving a direct-current dynamo made by the Triumph Electric Company. The distinguishing feature of the Warren alternating-current generators is that they are of the inductor type without brushes, commutator or moving wire. Both the armature and field windings are placed on the frame or stationary part of the generator, current being induced in the former by the rotation of iron pole pieces in close proximity thereto. The removal

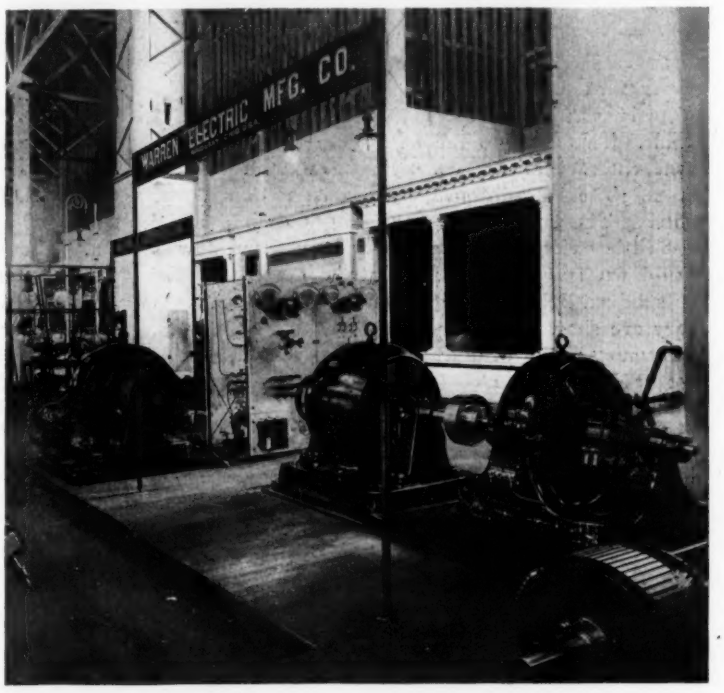


FIG. 8.—WARREN ALTERNATORS.

of all winding from the rotating element of the generator eliminates the necessity for any metallic electrical connection, and therefore does away entirely with all commutators, collectors or brushes. The only frictional surfaces are in the bearings. The circular frame of the Warren alternator is cast steel and the magnetic lines are all carried in the metal of the circular part of the frame, the directions of the lines being crosswise, instead of around the frame. The armature in reality consists of a ring of inwardly projecting poles around the interior of the generator. About each pole is a winding or armature coil, each being connected one to another to complete a series of coils for whatever voltage is required and the end of the series being brought out to the terminal board. The magnetizing coil is located around and supported by the flange in the interior of the frame. The placing of the armature winding on the stationary part of the machine permits increased facilities for insulation and makes feasible a winding for higher voltages. Within the limits of these higher voltages other conditions being suitable. It is possible to transmit power over correspondingly greater distances without the use of step-up transformers to raise the initial voltage of the machine. Regulation under varying load is obtained by reducing the armature reaction and self-induction to a low percentage. The rotor, the only thing about a Warren alternator that moves at all, is a cylinder of cast steel, into which the shaft is forced, and upon the surface of one end projections are built up of thin sheet steel. The other end is turned smooth and true and fits into the smooth bore of the pulley end of the circular steel frame with sufficient clearance. This cylindrical end of the rotor revolves in equilibrium in an intense magnetic field, which has no variation, it being always maximum. Through the teeth or projections of the toothed end of the rotor the magnetic flux is carried outwardly and delivered to the opposite element, the stationary armature. At this point the rise and fall occur, from zero to maximum, and the reverse, hence the necessity for the use of thin metal construction. The relation of copper to iron in the inductor alternator has been so proportioned that the regulation is very close without the necessity of compounding or other external devices.

Locke insulators are famous for high potential work and this is

due to the fact that the Locke Insulator Manufacturing Company has given exclusive attention to glass and porcelain insulators. These have been developed, the size enlarged, the forms made more various and the quality of material improved as the demand for high voltage power transmission has become more exacting. A fine array of these from the small glass ones to the combination, petticoated, porcelain insulators for 120,000 volts are exhibited on the Wesco space.

Surrounding Block 8 is a line of ornamental lamp posts made by the Electric Railway Equipment Company and upon these are Adams-Bagnall arc lamps. The lamps of this company are always artistically finished with stamped copper cases which are not only attractive in appearance but very durable. On the lamp rack the different kinds and styles of lamps are shown, but special stress is laid upon the alternating-current series arc lighting system. The primary

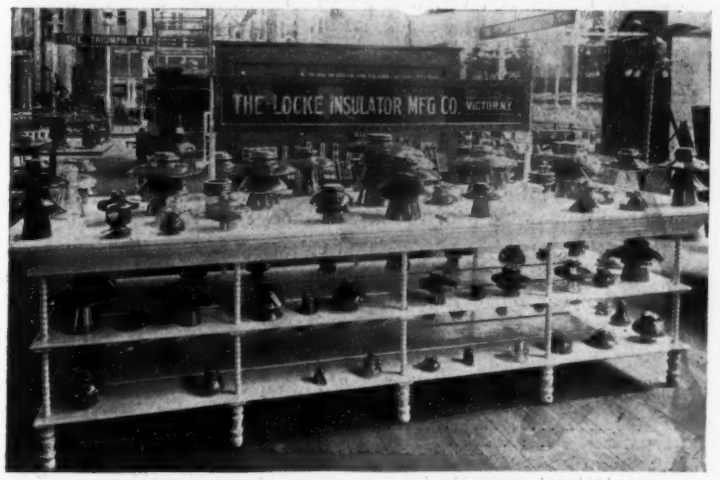


FIG. 9.—EXHIBIT OF LOCKE INSULATORS.

feature of this system is the constant potential transformer, which is exhibited with the working parts exposed. The essential parts of the regulator are an "M"-shaped iron element and a movable coil, partly counterbalanced by a weight working over a knife edge bearing. The coil is wound in sections to avoid excessive voltage between adjacent parts, and is constructed so as to run at a low temperature. In operation the weight is placed so as to balance that part of the weight of the coil not lifted by magnetism. For the operation of differential lamps, it is desirable to have the regulator free

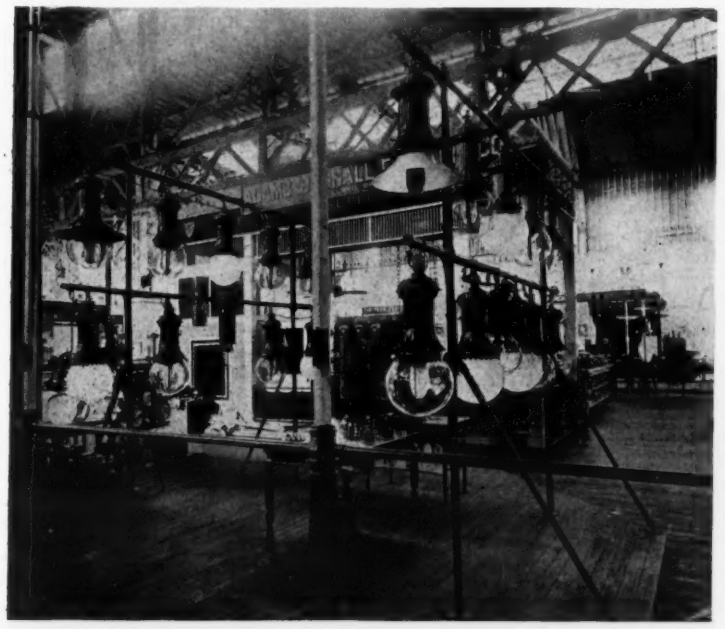


FIG. 10.—ADAMS-BAGNALL ARC LAMPS.

to respond to the slightest variation in voltage. Otherwise the lamps will take up the fluctuations resulting in unsteady and unsatisfactory lighting. This condition would indicate that no dash-pots on the regulator would be allowed. However, if the dash-pots be omitted, and short-circuits or other serious line troubles occur, the violent resultant movement of the regulator parts may damage the insulated windings. To reconcile these antagonistic conditions, dash-pots with extremely light moving parts are employed, so that at 75 per cent. load to full load, the regulator is left absolutely free to follow the variations in voltage, but in case of sudden reduction of load the dash-pots are picked up and the violent movements of the regulator checked enough to prevent any possible damage. The mechanism of the lamps consists of double solenoids and U-shaped cores, so related to each other that the voltage at the arcs remains constant.

The Diamond Meter Company has mounted seven different types of direct and alternating-current wattmeters. These are designed to meet the requirements of central station practice, being small, compact and pleasing in appearance. The moving parts are extremely light and are supported by a ball bearing which has proven

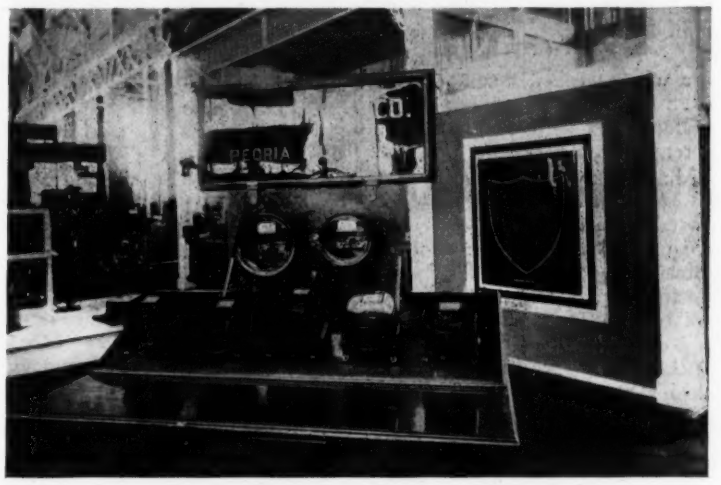


FIG. 11.—EXHIBIT OF DIAMOND METER COMPANY.

to have long life and great performance. The Scheeffer single-phase integrating wattmeter is especially designed to be unaffected by change of wave form or variation in voltage. This meter has a wide range of operation and it will record correctly the smallest possible load that would be placed on a meter up to a large overload. As this meter has no electrical contact points it will start to register on one-half of one per cent. of full load; it will carry an overload of fifty per cent. continuously and a greater overload for a short time.

The joint exhibit of the Warren Electric & Specialty Company and the Peerless Electric Company in the Wesco space is a very attractive one during the warm weather. Along the aisles there are five-column fans about seven feet above the floor and within the space a complete display of desk fans all in operation. In the center

FIG. 12.—MAKING ELECTRIC LAMP BULBS, PEERLESS EXHIBIT.

is a showcase containing material in the various processes of manufacture pertaining to incandscent lamps. On either side of this showcase is a mammoth incandescent lamp about three feet in height illuminated. In the front right and left corners are shown easel lampboards, one containing a display of the company's entire line of products and the other a display of "ancient" and "freak" lamps.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The activity in stocks continued on a large scale with a considerable increase in outside participation. Prices show steadiness and a bullish undertone after a reaction. Bonds are steady as a result of the easy money market. Considerable strength was shown in the prominent railroad shares, the highest prices of the year being reached in some instances. United States Steel issues, including the 5 per cent. bonds, advanced to the highest figures reached in a long time. The industrial list as a whole weakened somewhat, while advances were general in local traction stocks. Brooklyn Rapid Transit was active, 241,150 shares having been sold at prices ranging between 66¼ and 69⅜ (the latter the highest figure for the year), the closing quotation being 68⅜, which is an advance of 1 point. Metropolitan Street Railway also touched the highest price of the year for that stock—130⅜—and closed with a net gain of 5⅞ points, at 127½. Manhattan Elevated ran up to 164 and closed at 163, this being a net gain of 3¼ points. Interborough Rapid Transit was very strong on the curb market, closing at 160, the range of prices being between 147½ and 162⅝. All of the electrical securities, excepting Western Union, advanced and closed with good gains in price, the most marked change being in Allis-Chalmers preferred, which made a net gain of 11½ points, closing at 16½. The common stock closed at 14, an advance of 1½ points. A good business was done in General Electric at prices ranging from 174½ to 178¼, closing at 177, which is a net gain of 2 points. Westinghouse common was unusually active, the sales aggregating 18,000 shares. This stock closed with an advance of 4 points, the last quotation being 173. Preferred closed at 195, a net gain of 3 points. Western Union is off ½, closing at 92, while American Telephone & Telegraph is 4 points better off, in closing at 144, which is the highest price of the year. The curb market was generally firm and more active than during the previous week, the feature being Interborough Rapid Transit, as already mentioned. Following are the closing quotations of October 25:

NEW YORK

	Oct. 18	Oct. 25		Oct. 18	Oct. 25
Allis-Chalmers Co	10¼	14¼	Electric Vehicle	15	15½
Allis-Chalmers Co. pfd	50¼	53	Electric Vehicle pfd	22	21
American Tel. & Cable	92	91	General Electric	177⅛	175
American Tel. & Tel	143	144¾	Hudson River Tel.	..	..
American Dist. Tel	26	26	Interborough Rap. Tran.	148⅛	159⅛
Brooklyn Rapid Transit	67⅛	67¼	Metropolitan St. Ry.	122⅛	127
Commercial Cable	210	..	N. Y. & N. J Tel.	157	158
Electric Boat	38	37	Marconi Tel.	..	..
Electric Boat pfd	70	70	Western Union Tel.	92⅛	91⅛
Electric Lead Reduction	¼	¼	Westinghouse com	170¾	167
			Westinghouse pfd	193	185

BOSTON

	Oct. 18	Oct. 25		Oct. 18	Oct. 25
American Tel. & Tel.	143⅜	144¾	Western Tel. & Tel. pfd.	95	96
Cumberland Telephone	117	119	Mexican Telephone	1¾	1¾
Edison Elec. Illum	250	*251	New England Telephone	132	133¾
General Electric	177⅛	175	Mass. Elec. Ry	*14	12½
Western Tel. & Tel.	18	*20	Mass. Elec Ry. pfd.	54½	55

PHILADELPHIA.

	Oct. 18	Oct. 25		Oct. 18	Oct. 25
American Railways	47¾	48¾	Phila. Traction	97⅜	97¾
Elec. Storage Battery	73	72	Phila. Electric	7⅜	9¼
Elec. Storage Battery pfd.	73	72	Phila. Rapid Trans.	15	15⅞
Elec. Co. of America	9⅝	9¾			

CHICAGO

	Oct. 18	Oct. 25		Oct. 18	Oct. 25
Central Union Tel.	..	..	National Carbon pfd.	109¾	109
Chicago Edison	158	158	Metropolitan Elev. com.	23⅛	23¼
Chicago City Ry.	170	178	Union Traction	7⅛	9
Chicago Tel. Co.	128½	140	Union Traction pfd	34	35
National Carbon	37	*38			

* Asked

WESTINGHOUSE FINANCES.—It is stated that the Westinghouse Company proposes to issue $15,000,000 in debenture certificates, maturing in 20 years, bearing interest at 5 per cent. per annum and redeemable on call at 105 and accrued interest. In connection with the announcement the *Wall Street Journal* prints a statement from Mr. George Westinghouse. He is reported to have said: "In view of the large increase in the company's business, which will follow the introduction of the single phase system toward the operation of steam and interurban railways, the continued growth in the volume of sales of other standard lines of electrical apparatus, and the desirability of providing working capital for such largely increased business, there has been created by appropriate action of the board in accordance with a report of a committee of directors, an issue of debentures which can be retired from the sale of investment securities or earnings in lieu of a further increase of fixed capitalization." Following is the report of the committee of directors, consisting of Brayton Ives, George Westinghouse and George C. Smith, appointed to consider and report upon a comprehensive plan covering the requirements of the company for a period of years: "The large and continuous growth of your company's business, its prospective increase, and the moderate amount of its share capital, now $25,000,000, all issued, compared with its fixed and working assets of over $50,000,000, and the importance of having in reserve the necessary means of providing capital for the protection and extension of the company's business have been carefully considered by your committee. It is in our judgment a wise and conservative measure to provide this additional capital in the form of an issue of debentures, which can be retired, rather than by a permanent increase of capital stock, such debentures to be disposed of at the discretion of the board at such times and in such amounts not exceeding a reasonable aggregate as will meet best the company's capital requirements. We accordingly submit herewith a form of debenture agreement, prepared by counsel, securing an issue of debenture certificates of a total authorized issue of $15,000,000, and maturing in 20 years, bearing interest at 5 per cent. per annum and redeemable on call at 105 and accrued interest, and respectfully recommend its adoption for the reasons above set forth."

CHICAGO NORTHWESTERN ANNUAL.—The Northwestern Elevated Railroad Company, of Chicago, has issued its annual statement for the year ended June 30, 1904. We make the following comparisons:

	1904.	1903.	1902.
Gross	$1,724,929	$1,642,456	$1,499,014
Expenses	566,076	517,441	425,061
Net	$1,158,853	$1,125,015	$1,073,953
Charges, taxes, etc.	955,599	941,605	922,322
Surplus	$203,254	$183,410	$151,631

The surplus after charges of $203,254 amounts to 4.06 per cent. earned on the $5,000,000 preferred stock, as compared with 3.67 per cent. in 1903 and 3.03 per cent. in 1902.

LACKAWANNA TUNNEL RAILWAY.—The Lackawanna Tunnel Railway Company was incorporated with the Secretary of State at Albany, with a capital of $300,000. It proposes to build and operate a tunnel railroad from some point in Manhattan south of West Twenty-third Street, thence under the Hudson River to New Jersey, where connections will be made with railroads. The directors are as follows: W. H. Truesdale, E. G. Loomis, O. C. Post, Thomas W. Lee, George F. Wilson, A. D. Chambers, Frederick F. Chambers, William S. McGuire and Walter W. Ross, all of New York City. The tunnel is to be operated by "electricity, steam or other motive power," and is to afford a New York entrance for the Lackawanna Railroad.

PUBLIC SERVICE CORPORATION.—At a meeting of the Board of Directors of the Public Service Corporation in Newark, October 24, an issue of $7,250,000 of 5 per cent. five-year collateral trust bonds of the concern was authorized. They are to be secured by the deposit of approximately $11,500,000 of the bonds of the subsidiary corporations and the entire issue was sold to Robert Winthrop & Company, bankers, of New York. By this means the Public Service Corporation, which controls all the trolley and gas and electric power and light systems in the northern part of New Jersey, has provided for all its financial needs for extensions and improvements until 1906. All the plants are to be enlarged.

AMERICAN LIGHT & TRACTION.—The declaration of the initial dividend of 1½ per cent. on the common stock of the American Light & Traction Company came, the financial papers say, as an agreeable surprise to many of the company's shareholders. The company was formed in April, 1901, and acquired the controlling interest in gas and lighting properties located in various cities throughout the country. The earnings each year have shown substantial increases, and the placing of the common stock on a 3 per cent. basis per annum is taken to mean that the earnings for the current fiscal year will exceed those of the preceding year.

DIVIDENDS.—Chicago Edison directors have declared the regular quarterly dividend of 2 per cent., payable November 1. Messrs. Stone & Webster report that a semi-annual dividend of $2.50 per share has been declared payable November 1 on the capital stock of the Edison Electric Illuminating Company, of Brockton. American Graphophone Company's directors have declared the regular quarterly dividend of 1¾ per cent. on the preferred stock.

THE MANCHESTER (N. H.) TRACTION, LIGHT & POWER COMPANY has recorded a mortgage to the American Loan & Trust Company, to secure $2,000,000 worth of bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—Manufacturing plants are steadily increasing their output, and the purchase of a large tonnage of steel by the railways is a particularly gratifying feature of the week. All departments of the iron industry show much activity, and the new business comes from every line of industry and not from railways alone. There is more doing in plates for the account of lake shipbuilding concerns. Hardware is active in all lines and nails are selling freely. The other metals are stronger, copper being advanced by the large selling interests. The market is firm and the closing prices are 13⅛ to 13⅜c. for Lake, 13 to 13¼c. for electrolytic and 12⅞ to 13c. for casting stock. Railway earnings are satisfactory and collections continue to hold good, especially at the South. All over the country the jobbing demand is active in the principal staples and favorable reports are made from practically all lines of retail trade and from all sections. Lumber is quiet at the East, but at the West there is considerable building going on and white pine is up $1. The cotton market is tending downward, but other raw textile materials are strong with an upward tendency. There is an improvement in the mill situation in the East. Notwithstanding the favorable aspect of trade in general the number of failures in business increased during the week ending October 20 to 227, as compared with 196 the week previous, and 216 the corresponding week last year.

C & C FOREIGN AND DOMESTIC ORDERS.—The C & C Electric Company, 143 Liberty Street, New York, report recent receipt of a good batch of orders for motors, generators, including requisition for printing press equipments for various foreign countries. Two special printing press equipments of 30 hp and 35 hp respectively have been ordered for shipment to France and Australia. The 30 hp outfit will be used to operate a Goss press in a Parisian newspaper plant, while the other equipment will drive a Hoe press in a Sydney (Australia) printing establishment. A 10 hp motor has been ordered by Carr Brothers, exporters, 32 Broadway, New York, for shipment to Mexico, while six slow-speed motors arranged for chain drive and varying in capacity from 2½ to 7½ hp have been ordered for installation in a new large lithographic plant under construction in Toronto, Canada. Four motors have been ordered for driving ventilating apparatus in the new Trinity Building, New York. The motors range in capacity from 4 hp to 8 hp and are to be of special slow-speed type. The American Blower Company, Washington Life Building, New York, has the contract for the ventilating apparatus. The Landis Tool Company, of Waynesboro, Ia., has ordered 12 standard speed C & C motors, varying in capacity from 5 hp to 35 hp and intended for driving machine tools in the Landis shops. The Crescent Ice Company, of New Orleans, La., has ordered a 150 kw generator for light and power use in its new plant. The generator will be direct-connected to an American-Ball engine. The C & C people will also execute an order for a large switchboard for the Crescent plant. The Conkling-Armstrong Terra Cotta Company, of Philadelphia, has sent in a repeat order for a 100 kw generator to be direct-connected for light and power purposes to a Reeves engine. Six motors ranging from 7½ hp to 15 hp have been ordered for running various machinery—sawmill, planers, etc.—in Portsmouth, Va. The Kenwood Bridge Company, of Chicago, is to be shipped a 100 kw belted generator for driving motors and a special 50 hp variable speed motor has been ordered by the Sugar Apparatus Manufacturing Company, of Philadelphia, for shipment to Cuba, where it will be used for driving sugar machinery on one of the large plantations. Four C & C dynamos, ranging from 4½ to 18 kw and arranged for direct connect to Nash gas engines, are to be shipped to Ossining, N. Y., Jersey City, N. J., and Chicago, Ill., for lighting outfit. The Krieder Shoe Company, of Anville, Pa., has ordered a 55 kw generator for direct connection to a Harrisburg engine and to be used for power purposes.

THE VALENTINE ELECTRIC SIGN COMPANY was recently incorporated for the purpose of engaging in the business of manufacturing and erecting electric signs of every description. The capital is $25,000. A feature of the business will be the manufacture of electric letters, of all styles and sizes, which will be sold to electric contractors and electric light stations throughout the United States. This will enable the contractor to contract for the erection of complete electric signs, without the necessity of having to manufacture the letters, thus making a profitable addition to its business. Another feature will be the renting of electrical festoons, designs and decorations of all kinds for temporary work, thus avoiding the necessity of purchasing such decorations outright, as has been the custom heretofore. The company will be located in Atlantic City, where it has secured ample quarters for the requirements of the business, and will be managed by the following officers: C. F. Munder, president; T. E. Valentine, vice-president and general manager; George W. Vallee, secretary and treasurer. Mr. C. F. Munder is president and treasurer of the Munder Electric Company, of Springfield, Mass., which is manufacturer of incandescent lamps. Mr. T. E. Valentine for the past five years has been manufacturing and erecting electric signs in Atlantic City. Mr. George W. Vallee until recently has been vice-president of Vallee Brothers' Electrical Company, of Philadelphia. The New York office will be at 26 Cortlandt Street.

THE AMSTERDAM AUTOMATIC TELEPHONE COMPANY, of Amsterdam, N. Y., is completely rebuilding its plant. Some of the distinctive features are an all-cable plant; several thousand feet of underground construction; a central energy plant, with modern four-party line selective instruments, and a water turbine for driving a generator for lighting the building and operating the charging and ringing machines. The water is taken from the city water works, whose supply comes from the Adirondack Mountains. There will be several different classes of rates, such as measured service, four-party selective and individual service. The company is erecting a new two-story building of pressed brick and stone. It expects to make the plant one of the best in the State of New York. The plant is designed with a special view to low maintenance and low depreciation, which means a high earning on the investment. Supervision of the construction, soliciting and operating is under the management of L. W. Stanton, consulting and construction telephone engineer, of Cleveland, Ohio.

THE ABNER DOBLE COMPANY, of San Francisco, has secured a contract from the South San Francisco Land & Improvement Company, for installing a pumping outfit for the city waterworks system in South San Francisco, San Mateo County, Cal. The installation will consist of a compound centrifugal pump direct-connected to a 75-hp induction motor, delivering 900 gallons per minute against a head of 200 ft. The Doble Company has also contracted to erect a sub-station, distributing lines, etc., for power and lighting throughout the new manufacturing center which is being built up at South San Francisco, San Mateo County, Cal. The distributing company will be known as the South San Francisco Power & Light Company and will take transmitted power from the Standard Electric Company.

COPPER TRADE OUTLOOK.—John Stanton, a copper authority, says, as to the copper situation: "Early in the year things were bad. Steel was down and general business had slackened up. With it the demand for copper fell and producers shaded prices to secure orders. Then came the foreign exports. At first we thought them temporary. I was pessimistic as to their continuance, but recently I have talked to men who have just returned from Europe and they say the electrical works are running night and day, particularly on the Continent, and they could do more business had they the plants to handle it. Our consumers have used the surplus up. The business outlook is good."

JEANESVILLE IRON WORKS.—The increase in the power plant of the Jeanesville Iron Works, Hazelton, Pa., engineered by Dodge & Day, Philadelphia, contemplates the installation of a 75-kw, 120-120-volt De Laval steam turbine generator. The equipping of the additional switchboard panel will be done by Walker Electric Company, Philadelphia, Pa. This firm will also install some 400 hp Westinghouse motors, ranging in speed from 5 hp to 150 hp, direct-current, 230-volt, in the new plant of the Victor Talking Machine Company, Camden, N. J., as well as an Albro-Clem electrically-operated freight elevator having a lifting capacity of 7,600 pounds at a speed of 40 ft. per minute.

OKLAHOMA GAS & ELECTRIC COMPANY.—In the reorganization of the Oklahoma Gas & Electric Company, which took place on October 20, the following officers and directors were elected: C. B. Ames, Oklahoma City, president; H. M. Byllesby, Chicago, vice-president; D. T. Flynn, Oklahoma City, secretary; A. H. Grimes, Guthrie, treasurer; Rufus C. Dawes, Chicago, director; Samuel Insull, Chicago, director; H. M. Newton, Sparta, Wis., director. R. J. Graf, of Chicago, was appointed assistant secretary and treasurer. H. M. Byllesby & Company were retained as engineers for the property.

ORDERS FOR HARRISBURG SPRAGUE OUTFIT.—Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York, have secured a contract for a 40 hp Harrisburg-Fleming side crank engine for direct connection to a 25 kw Sprague generator. This outfit is intended to be utilized for lighting the plant of the E. & G. Brooke Iron Company, of Birdsboro, Pa. A 75 hp Harrisburg-Fleming side crank engine has also been ordered for the lighting plant of the Hotel Empire, Sixty-third Street and Columbus Avenue, New York. The generator will be a Sprague machine of 50 kw capacity.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has secured a 14-year lease on the building to be erected by Joseph Downey, at the southwest corner of Jackson Boulevard and Desplaines Street. The building is to be six stories in height with a frontage of 95 feet and width of 100 feet.

General News.

THE TELEPHONE.

HUNTSVILLE, ALA.—The property of the Huntsville, Guntersville & Gadsden Telephone Company was sold at public outcry recently by decree of Chancery Court and the creditors bid it in. The purchasers own the principal stock of the Gurley and of the New Hope telephone companies and will merge the systems.

REDDING, CAL.—The Sunset Telephone Company will build another line between this city and Dunsmuir.

JACKSONVILLE, FLA.—The Jacksonville Telephone Company has been reorganized by the formation of a new company, with J. C. L'Engle, Dr. W. Hume Shine and D. T. Gerow as the stockholders, incorporators and the officers of the new company.

MATTOON, ILL.—The Mattoon Telephone Company has filed its acceptance of the ordinance that permits it to lay its wires underground in the business district. An engineer is drawing plans and making specifications for the work which will be taken up immediately.

KEWANEE, ILL.—The Henry County Telephone Association has elected the following officers: President, P. D. Ransom, Atkinson; secretary, George Murphy, Cornwall; directors, Wm. Bristol, Kewanee; Jas. Moon, Annawan; Norman Shearer, Cornwall. A new constitution was adopted.

CHANDLER, IND.—The Chandler Telephone Company has been formed with $10,000 capital.

GRANTSBURG, IND.—The Temple Telephone Company has been incorporated by Jos. Blevins and others. Capital, $5000.

INDIANAPOLIS, IND.—The National Telephone & Telegraph Company, of West Virginia, has filed a certificate of incorporation under the laws of Indiana. The capital to be invested in Indiana is $175,000 and the principal office will be in Fort Wayne. Wm. L. Moellering is the State agent, while Frank H. Cutshall, Wm. Paul, George T. Cox and others, all of Fort Wayne, are Indiana stockholders.

ESTHERVILLE, IA.—The Emmet County Telephone Company seeks a local franchise for a new exchange.

WATERLOO, IA.—Telephone wires in the business district at Waterloo are to be placed underground.

GILMORE, IA.—The Iowa Telephone Company is putting up new wires between this place and Humboldt.

MANSON, IA.—The Mutual Telephone Company will expend $4000 in improvements to the local exchange.

REINBECK, IA.—The Iowa Telephone Company will make improvements to the system here at once, both local and long distance.

DAVENPORT, IA.—The Eldorah, Hough Woods & Point Pleasant Telephone Company has been incorporated with a capital stock of $10,000. Directors: E. H. Sheldon and others.

OGDEN, IA.—The Marcy Mutual Telephone Company has re-elected all the present directors as follows: Simon Peterson, Chas. Williams, John Olson, A. B. Morgan, John Dixon, William Highland, J. S. Miller, Chas. Honstrom and John Sparks.

TOPEKA, KAN.—The Topeka Independent Telephone Company, since its organization in 1901, has experienced a remarkable increase in business. Since the original installation, it has been necessary to increase the capacity at least once every nine months. The American Electric Telephone Company, which furnished the original equipment and additional increases, has just completed the construction of another section of switchboard for the Topeka exchange, and the company is now giving service to almost 2500 subscribers.

CRYSTAL CITY, MAN.—A local telephone system with 50 subscribers will be put in here by the residents.

CALUMET, MICH.—Calumet's telephone system is to be entirely overhauled within the next six weeks.

LENNON, MICH.—The Shiawassee & Genesee Mutual Telephone Company of Lennon, capital $10,000, has filed articles of incorporation with the Secretary of State.

CADILLAC, MICH.—Having decided to extend its lines to Manwataka, Boon and Harietta, the Citizens' Telephone Company will begin the construction work within a few days, at least in time to be in operation in the three villages before the first of the coming year.

MINNEAPOLIS, MINN.—The report for the year ending Oct. 1 of the Twin City Telephone Company, the independent company operating in this city and St. Paul, is as follows: Gross earnings, $434,570; operating expenses, $197,755; net earnings, $236,244; interest, $50,000; surplus for stock, $186,244; dividends, $85,000; surplus, $101,244. The company has in operation 12,923 telephones.

GREAT FALLS, MONT.—The Cascade County Rural Telephone Company will build a line to Black Butte at once.

LINCOLN, NEB.—The Western Telephone Company recently incorporated at Lincoln, announces that it will build at once toll lines in all directions from Lincoln. It has already completed the line to Palmyra to connect with the Nebraska City lines, and is now at work on lines south to Beatrice and west to Crete and Kearney. It also intends building north to Columbus.

RALEIGH, N. C.—The Southern Bell Telephone Company is reported to be endeavoring to secure control of the Raleigh Telephone Company, where both now operate systems.

LAURINBURG, N. C.—The Southern Bell Telephone Company, having secured control of all outside connections at Laurinburg has notified the independent company that the latter cannot get connections outside after the expiration of a recent notice. The Bell Company has offered to rent the independent system.

DENHOFF, N. D.—P. H. Jeardean contemplates extending a telephone line to Washburn, with branches to Harvey and Goodrich.

WESTHOPE, N. D.—Messrs. Lillie, Rinkel, Neville and Frank Collins have been granted a franchise to install a local telephone exchange. They will do business as the Westhope Telephone Company.

CENTERBURG, OHIO.—The Central Ohio Telephone Company has increased its capital stock from $10,000 to $50,000.

CINCINNATI, OHIO.—After a spirited debate between the members of the Millcreek Valley Business Men's Club and representatives of the Cincinnati & Suburban Telephone Company, regarding the recent increase in tolls to the northern end of the valley, the club voted to have all instruments removed from Carthage, Elmwood Place and St. Bernard. The club will petition the councils of the various villages to grant telephone franchises to independent companies.

MEDFORD, OKLA.—The Medford Rural Telephone Company has been formed with $3000 capital stock. The incorporators are D. L. Cline, Z. Z. Sharp and W. S. Long.

GUTHRIE, OKLA.—A charter has been issued to the Union City Telephone Company of Canadian County for 20 years with a capital stock of $5000 and the following incorporators: F. L. Wilkins, T. M. Kirby and S. H. Fulring, all of Union City.

WILLAMETTE, ORE.—The West Oregon Telephone Company has been organized with a capital stock of $2000. Incorporators: Chas. Baker, G. P. Gross and E. S. Kruse.

CHESTER, PA.—The Delaware & Atlantic Telegraph & Telephone Company is planning an extension of its cable system from Ridley Park to Glenolden.

GRANITEVILLE, S. C.—The Graniteville Telephone Company has been chartered with $3500 capital, by W. A. Giles and others.

BURBANK, S. D.—T. S. Maude and Nels Anderson are forming the Burbank Telephone Company.

ABERDEEN, S. D.—The new Dakota Central Telephone Company will own and operate the central Dakota, the western Dakota, the southern Dakota, the southern Minnesota and the Iowa, Minnesota and Dakota lines. There are about 10,000 miles of circuit.

ONANCOCK, VA.—The Diamond State Telephone Company, of Delaware, which recently acquired control of all the local telephone companies, is now busy installing the local and long distance systems.

EVERETT, WASH.—The Skagit County Farmers' Mutual Telephone Company is seeking a local franchise.

SUPERIOR, WIS.—The City Council has amended the franchise ordinance of the People's Telephone Company, permitting the latter to increase its rates.

ASHLAND, WIS.—The Wisconsin Telephone Company will expend $40,000 in installing a new system here.

ELECTRIC LIGHT AND POWER.

WESTPORT, CONN.—The officials of the Westport Water & Electric Light Company have stated that they will buy electrical power either from Norwalk or South Norwalk for $1800 a year, according to the terms of a bid recently received.

NEW CASTLE, DEL.—The Delaware Water Improvement Company has been incorporated to construct water works and an electric light plant in New Castle. Capital $150,000.

BUFORD, GA.—The town of Buford has voted $20,000 for electric light and water bonds.

CAMILLA, GA.—The citizens have voted to raise $20,000 bonds for water works and an electric light plant.

GREENSBORO, GA.—The town of Greensboro will vote on November 8 on the question of issuing electric light bonds for a municipal plant in the town.

LITCHFIELD, ILL.—The City Council has granted a franchise to Chas. B. Munday, Jr., to construct and maintain an electric light and gas plant in Litchfield.

CHICAGO, ILL.—The La Grange Service Company has been incorporated for the operation of heat, light and power plants. Buell McKeever, Geo. C. Madison and Harry J. Dunbaugh are the incorporators. The capital stock is $100,000.

MUNCIE, IND.—The City Council is considering the advisability of installing a new city electric light plant.

FRANKFORT, IND.—F. M. Ingler has purchased the local electric light plant and will expend $20,000 in making improvements.

ELKHART, IND.—The Indiana & Michigan Electric Company is said to be preparing plans for the construction of a transmission line from its dams along St. Joseph River, to carry current to Indianapolis and Louisville, Ky.

SUMNER, IA.—Hartig & Hellier, of Minneapolis, have secured a franchise for an electric light and power plant.

SHENANDOAH, IA.—The Shenandoah Artificial Ice, Power, Heat & Light Company has purchased the local light plant, and will make extensive improvements.

CLYDE, KAN.—Maynard E. Maggart, of Chicago, Ill., will construct an electric light plant here to cost between $8000 and $10,000.

DEERFIELD, MASS.—The Greenfield Electric Light & Power Company, of Greenfield, has decided to petition for a franchise to erect poles and string wires for lighting both Deerfield and South Deerfield.

ITHACA, MICH.—Contracts for machinery and material for the electric light plant have been awarded as follows: For the engine, N. H. Straight Mfg. Company, of Kansas City, Mo., $1725; boilers, Shaw-Kendall Engine Company,

of Toledo, Ohio, $4000; generators, arc lamps and other electrical equipment, Fort Wayne Electric Company, of Fort Wayne. Total cost, about $9000.

WINTHROP, MINN.—Bids will be received Nov. 5 by the Village Council for $7000 electric light and water works bonds. C. A. Echilling is Village Recorder.

ABERDEEN, MISS.—The municipal electric light plant in this place will be rebuilt during the next year.

LACONIA, N. H.—At a recent special meeting of the Meredith village district it was voted to enter into a five-year contract with the electric light company for furnishing a sufficient number of lights.

ALBUQUERQUE, N. M.—The Albuquerque Electric Power Company has been organized here with a capital of $50,000 by Wm. B. Childers and Edward Callen.

ILION, N. Y.—Electric light improvement bonds to the amount of $25,000 have been sold.

NEWARK, N. Y.—The New Light, Heat & Power Company has secured the contract for lighting the streets for 5 years at $85 per arc lamp per year for street lights of 2000 candle-power.

SARATOGA SPRINGS, N. Y.—The Saratoga Gas, Electric Light & Power Company secured the contract for lighting the streets and public buildings for 4 years at $90 per light per year for 2000-cp arc lights.

NORMANSVILLE, N. Y.—It is stated that the Albany Electric Power Company proposes to develop the water power of Normanskill Creek for power purposes. The office of the company is reported located at Normansville. Wm. M. Slingerland is president.

NIAGARA FALLS, N. Y.—The Suburban Power Company, an allied company of the Niagara Falls Power Company, was incorporated on Oct. 11 with a capital of $10,000, to distribute electricity in Niagara, La Salle, Wheatfield, Pendleton, Amherst and Williamsville. Directors: D. O. Mills and Edward A. Wickes, New York; Wm. B. Rankine, Geo. W. Davenport and Delancey Rankine, Niagara Falls.

ASHEVILLE, N. C.—The Asheville Milling Company has contracted with the W. T. Weaver Power Company for the necessary electric power from the French Broad River to operate the plant.

MORGANTOWN, N. C.—It is reported the H. L. Millner, of Morgantown, has relinquished all claims to the light and water franchise granted him by the town of Lancaster, S. C., in favor of Col. T. Y. Williams and Col. Leroy Springs, of Lancaster, who will likely establish the two systems in the town.

SALISBURY, N. C.—G. L. Whitney, president of the Whitney Reduction Company, and Secretary F. L. Stephenson are making preparations for the completion of the power plant to develop the water power of Yadkin River, 18 miles from this city. It is estimated that the work will cost about $5,000,000.

SIDNEY, OHIO.—The Sidney Electric Light Company proposes to change over to the series alternating-current arc system.

WARREN, OHIO.—The Phoenix Electric Company, of Warren, has been incorporated with a capital of $5000, by W. A. Smith, Glen C. Webster, Edwin O. Izant and others.

PROSPECT, OHIO.—The Prospect Electric Light & Power Company has been incorporated with a capital of $10,000. The incorporators are George Whysell, W. A. Block, J. S. Webb, A. L. Neereamer and J. W. Pettey.

OKLAHOMA CITY, O. T.—The Oklahoma Gas & Electric Company, of Oklahoma City has secured a bond issue of $1,000,000 to be expended in betterments.

HAINES, ORE.—The Council has granted J. F. Bryant a franchise for an electric light plant.

LA GRANDE, ORE.—The La Grande Water Storage Company is to construct an electric plant at a cost of $100,000. Contract will probably be let in November. E. W. Cummings, Seattle, Wash., is engineer.

DALLASTOWN, PA.—The citizens have voted to construct an electric light plant.

GALLITZIN, PA.—There is a movement here for the construction of an electric light plant.

WEST CHESTER, PA.—The Borough Council has renewed the contract with the Edison Electric Illuminating Company for lighting the streets of the town for a period of 5 years, at $10,055 per year.

PITTSBURG, PA.—The Select Council has passed an ordinance granting the Duquesne Light Company a franchise to furnish electric light, heat and power throughout the city.

ANDERSON, S. C.—A charter has been granted to the Piedmont Electric Company, of Anderson, with a capital of $25,000. Incorporators: E. S. Moorer, G. W. Evans and H. H. Watkins.

ROCK HILL, S. C.—The Catawba Power & Electric Company has contracted to supply 100 horse-power to the plant of Winthrop College and 75 horse-power to the Rock Hill Buggy Company at Rock Hill.

BURLINGTON, VT.—Chas. Stone has secured the contract for constructing a building for the municipal electric light plant for $7750. H. M. McIntosh is city engineer.

BELLOWS FALLS, VT.—The Fall Mountain Electric Light & Power Company, of this place, is now running poles to Alstead, N. H., and doing wiring in that place both for light and power. The company already has lines running to Walpole, N. H., and to Westminster and Saxtons River.

LANDER, WYO.—Edward Fanning, of Stewartsville, Minn., with R. A. Morse, of Lander, Wyo., is interested in the construction of an electric plant at Lander, to cost $50,000. The power will be used for running mines.

THE ELECTRIC RAILWAY.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company has increased its capital stock from $300,000 to $1,000,000.

FORT SMITH, ARK.—The Mount Mena Traction Company has been incorporated by James L. Hale, E. J. Mills, G. H. Little, G. B. Noble, Alfred T. Bissell, W. W. Lowery, James W. Hale. Alfred T. Bissell is president; E. J. Mills, vice-president, and James L. Hale, secretary and treasurer. The capital stock is $50,000.

LITCHFIELD, ILL.—The Litchfield Traction Company has been incorporated with a capital of $5000. C. B. Munday, Jr., M. J. Buscher and G. L. Settlemire are the incorporators.

DECATUR, ILL.—The Bloomington, Clinton & Decatur Electric Railroad Company has been incorporated with a capital stock of $50,000. The incorporators are W. R. Carle, of Wampella, Ill.; Harry Schlaudman, of Decatur, Ill.; L. R. Murphy, of Clinton, Ill.; Thomas N. Leavitt, of Macon, and H. W. Knight, of Kansas City, Mo.

ANDERSON, IND.—The Union Traction Company has abandoned the project to build a line from this city to Middletown because of unfriendly acts of the farmers and the high prices asked for rights of way in Henry County.

WABASH, IND.—S. L. Nelson has been discharged as receiver of the Fort Wayne & Southwestern Traction Company, operating 45 miles of track between Fort Wayne and Wabash. There is little doubt, now that all litigation has been disposed of, that the consolidation of the Southwestern and the Fort Wayne & Wabash Valley line from here to Logansport will be effected.

INDIANAPOLIS, IND.—The Indianapolis & Eastern Electric Company is increasing the capacity of its power house, which is located at Spring Lake, 5 miles east of Indianapolis. A new Hamilton cross-compound engine, made by the Hooven, Owens, Rentschler Company, of Hamilton, Ohio, has been installed, also a 1000-kw, 365-volt, 25-cycle, alternating-current generator. The voltage is raised to 13,200 for transmission, and is stepped down at the substations to 650 volts direct-current, at which pressure it is fed to the service wires. A Wheeler condenser also has been added to the equipment.

SHREVEPORT, LA.—An ordinance has been passed granting the Highland Park Traction Company a franchise to build additional lines here.

BAY CITY, MICH.—The Detroit, Pontiac, Lapeer & Northern Electric Railway Company has been incorporated with $1,000,000 capital. The new concern takes over nothing from the old company, assumes none of its liabilities and is after a new franchise. The following officers have been elected: E. H. Whitcomb, of Davenport, Ia., president; William Perkins, of Detroit, vice-president; J. H. Christian, of Chicago, treasurer; L. A. Rockwell, of Chicago, secretary; O. J. Pribe, of Detroit, general manager; C. T. Gregory, of New York, consulting engineer.

WOODVILLE, MISS.—The Woodville-Fort Adams Electric Railroad Company has been organized. The line is to be 23 miles long. The consulting engineer, George W. Borde, of New Orleans, reports very favorably on the project. The officers elected by the board of directors are L. T. Ventres, president; Charles Cohen, vice-president; W. H. Woods, secretary; James M. Sessions, treasurer.

OLEAN, N. Y.—The Olean Street Railway Company has been granted a franchise by the village board of trustees of Salamanca, to construct and operate an electric railway between the latter place and East Salamanca.

ITHACA, N. Y.—The Cayuga Lake & Ithaca Railroad Company has been incorporated with a capital of $80,000 to construct a line seven and one-half miles, connecting Ithaca and Ludlowville. The directors are John W. Wright, Dryden; J. R. Emery, Montclair, and E. A. Dender, Ithaca.

SYRACUSE, N. Y.—Local and out-of-town capitalists have become identified with the project of building an electric railway between Syracuse and South Bay. Franchises and rights of way are being secured and a construction company has been organized and an engineer is at work. At the annual meeting of the stockholders of the Syracuse & South Bay Railway Company directors were elected as follows: George Skiff, of Salina; Hiram W. Plumb, Willis B. Burns, Willard R. Kimball, W. K. Niver, George D. Chapman, Louis L. Waters, Frank L. Barnes and Frederick T. Pierson, of Syracuse. The directors will meet soon to organize. The Cleveland Construction Company has been organized to build the proposed railroad. The officers of the company are Frederick T. Pierson, president, and D. E. Balsley, secretary and treasurer. The present capitalization of the company is $10,000. The consulting engineer is George C. Towle.

EAST LIVERPOOL, OHIO.—Marcus Aarons, of Pittsburg, and associates are planning to extend their new line from East Liverpool to Kenilworth, W. Va., a distance of 6 miles. A large brick plant is to be located at Kenilworth.

MARION, OHIO.—The Marion-Bucyrus Railway & Light Company has elected officers as follows: Ellis Bartholomew, of Toledo, president; S. S. Thorn, of Toledo, vice-president; George K. Canfield, of Cleveland, secretary; Charles B. Selby, of Warren, treasurer.

TOLEDO, OHIO.—The Toledo Urban & Interurban Railway Company has increased its capital stock from $100,000 to $1,000,000. This company is building a line from Toledo to Maumee to furnish a new entrance for the Toledo, Bowling Green & Southern Traction Company, which it will acquire after the first of next year.

DAYTON, OHIO.—The Dayton, Springfield & Urbana Railway Company has acquired the plant of the Urbana Electric Light & Power Company and will transfer the equipment to the company's sub-station building. A 150-hp Miller gas engine has been purchased and will take the place of the steam equipment for generating current.

DAYTON, OHIO.—L. W. James has been appointed receiver for the Dayton & Kenton Traction Company, a company headed by E. M. Hopkins,

of New York, which proposed to build an extensive system between Dayton and Kenton, with numerous branches. The company was unable to secure financial backing. The assets will not exceed $500.

TOLEDO, OHIO.—The Patrick Hirsch Construction Company, of Toledo, which is building the Wauseon-Bryan extension of the Toledo & Indiana Railway, is placing contracts for the power house equipment and additional rolling stock required. The power station, located at Stryker, will contain two 1000-hp compound condensing engines, four 400-hp water-tube boilers, together with electrical equipment for handling current at high voltages.

INDEPENDENCE, ORE.—The Independence & Salem Electric Railway Company has been incorporated for the purpose of building an electric railway to connect Salem and Independence. The incorporators are J. M. Stark, D. Calbreath and C. L. Fitchard.

PITTSBURG, PA.—The work of constructing the Mount Washington tunnel of the Pittsburg Railways Company has been completed after two years' work. The tunnel is 3500 ft. long, 24 ft. wide and 21 ft. high.

SHARON, PA.—The Greenville Electric Railway Company has been granted a franchise by Council at Greenville for a line from Sharpsville to Conneaut Lake. The line will be 50 miles long. The right of way has been secured.

YARDLEY, PA.—The Trenton, Lambertville & New Hope Passenger Railway Company, which is pushing work on its new trolley line, will locate its power house here. Fully equipped the power house is expected to cost over $100,000, and President Cadwalader says that orders for machinery, to cost over $50,000, have already been placed.

DARLINGTON, WIS.—The Business Men's Association of this city is pushing the enterprise of building an electric railway for carrying passengers and freight between Dubuque, Ia., and Madison, Wis. The distance is 77 miles. W. H. Winter, manager of the Darlington Electric Light & Water Power Company, has been active in starting this enterprise, and is said to have interested prominent railroad men in Chicago and elsewhere.

FORT WILLIAM, ONT.—The Mount McKay & Kababeka Falls Railway Company has asked the City Council for a franchise for the operation of an electric street railway.

MONTREAL, QUE.—The Montreal Terminal Railway Company has reorganized, the new board of directors being D. Murphy, president; S. H. Ewing, vice-president; T. B. Macauley, James Tasker, T. P. Cleghorn, H. H. Melville, C. H. Catelli, J. P. Mullarkey and Mr. McKenzie.

NEW INDUSTRIAL COMPANIES.

S. H. COUCH COMPANY, INC., Boston, Mass., (telephones) has been incorporated with a capital of $25,000. President and treasurer, Samuel H. Couch.

THE UNITED ELECTRICAL MFG. COMPANY, of Newburg (Cleveland) Ohio, has been incorporated with a capital of $50,000, by H. J. Robinson and others.

DELAWARE WATER IMPROVEMENT COMPANY, New Castle, Del., has been incorporated to conduct power water works and an electric light plant at New Castle; capital, $150,000.

THE CHEMUNG AUTOMOBILE COMPANY, Elmira, N. Y., has been incorporated to deal in automobiles. Capital, $5000. The incorporators are F. H. Rees, Chas. W. Ufford and C. R. Sayles.

THE ORIGINAL AUTOMOBILE SUPPLY COMPANY, has been incorporated at St. Louis, with a capital stock of $10,000. The stockholders are A. L. Dyke, Carrie Dyke and Charles Peters.

THE ELECTRIC TYPEWRITER COMPANY, Cincinnati, Ohio, has been incorporated with a capital of $100,000, by A. H. Peters, E. P. Ford, M. F. Cockerill, Robert Ewing and M. S. Schatzman.

THE SYLVAN ELECTRIC BATH COMPANY, New York, N. Y., has been incorporated with a capital of $500,000. The directors are J. H. Lancaster, Z. T. Jones and Franklin Barritt, New York.

THE PENN ELECTRIC COMPANY, New York, N. Y., has been incorporated with a capital stock of $1000. The incorporators are Charles Bruning, L. H. Amsler and Knud Maerch, all of New York.

THE SPIES GENERAL ELECTRIC MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital of $25,000. The directors are P. H. Spies, S. Heyden and David E. Aarons, New York.

THE CHICAGO STAGE LIGHTING COMPANY has been incorporated with a capital of $2500 for the manufacture of electrical apparatus by J. J. Fanning, G. E. Stevenson and W. J. Stevenson.

THE WOOLEY ELECTRIC MFG. COMPANY, Lima, Ohio, has been incorporated with a capital of $200,000, by Leonidas G. Wooley, George V. Guyton, James E. Lowry, Wm. B. Jack and James W. Halfhill.

THE EDMONSTONE COMPANY, New York, has been formed to manufacture and supply telephone apparatus; capital, $100,000. Directors: Burton Thompson, Daniel M. Miers and John E. Ruston, of New York.

THE PHOENIX ELECTRIC COMPANY, Warren, Ohio, has been incorporated with a capital stock of $5000. The incorporators are W. A. Smith, Glenn C. Webster, Edwin O. Izaut, Wm. Coole and Washington Hyde.

THE INNOVATE MANUFACTURING COMPANY has been incorporated in Chicago to manufacture electrical apparatus. The capital stock is $5000. John O'Connor, Harry D. Irwin and Amos H. Robillard are the incorporators.

THE UNITED POWER & WATER DEVELOPMENT COMPANY, Camden, N. J., has been incorporated with a capital of $15,000. The incorporators are Chas. H. Royal, Thomas Craig, D. B. Donce, J. R. Fell and Joseph F. Cotter.

THE ACME ELECTRIC TELEPHONE COMPANY has been incorporated in Chicago by A. B. Schafner, Harry Goodman and Adolph Kreis. The capital stock of the new company, which will manufacture electrical supplies, is $10,000.

THE ELSTON AUTOMOBILE COMPANY, of Indianapolis, Ind., has incorporated for the purpose of manufacturing and selling automobiles and electrical supplies. The capital stock is $10,000. Sidney W. Elston is president and E. C. Vagen, secretary.

THE KNOBLOCK-HEIDEMAN MANUFACTURING COMPANY has incorporated at South Bend, Ind., with a capital stock of $20,000. The company will manufacture and sell electric and mechanical appliances. Otto M. Knoblock is president and W. G. Heideman, secretary.

THE WILLIAMS ELECTRICAL MACHINE COMPANY, Akron, Ohio, has been incorporated with a capital stock of $100,000. The incorporators are Harry Williams, J. F. Townsend, W. S. Matthias, Talma R. Smith and J. V. Welsh. The company will manufacture electrical machinery and supplies.

PERSONAL.

J. M. HUMISTON.

MR. JOHN M. HUMISTON, now holding an important position as superintendent of underground construction and line distribution with the Chicago Telephone Company, will soon sever those relations and enter the employ of the firm of McMeen & Miller, an organization lately effected by Samuel G. McMeen and Kempster B. Miller, the well-known telephone engineers. Mr. Humiston is a western man, educated in Lake Forest University, near Chicago, and in the Armour Institute of Technology, Chicago. He has been engaged with the Chicago Telephone Company for the last eight years, since leaving Armour Institute. In vacations during his college work, he had practical training with the Metropolitan West Side Elevated Railway and the Bankers' Electric Protective Company, of Chicago. Mr. Humiston is particularly well versed in construction work. His study and practical work in connection with electrolysis of underground pipes for gas, water and electric purposes, has made him an authority in this line. His paper on this subject, read before the New Orleans meeting of the National Gas Association in 1902, resulted in his being consulted by a number of interests confronted with this problem. He is consulting engineer for a dozen or more gas and electric power companies, whose underground construction requires preventive and curative work to be done. McMeen & Miller are undertaking the work, as electrical engineers, of the entire construction of the new independent telephone system in Quincy, Ill., and Mr. Humiston will be actively connected with that project.

SIGNOR MARCONI.—Signor G. Marconi was a guest at the Italian Embassy in Washington a few days last week, and on Saturday he was the guest of President Roosevelt at luncheon.

MR. F. S. HICKOK, who was for 13 years in the engineering department of the Western Electric Company, has recently become connected with the Chicago office of the United Telepherage Company. His work will be that of sales engineer, for which his connection with the dynamo and motor work of the Western Electric Company has well fitted him.

MR. F. NICHOLLS, vice-president and general manager of the Canadian General Electric Co. and vice-president of the Dominion Iron & Steel Company, says that the period of depression in the iron and steel market of Canada has passed and that the outlook now is that all the Canadian plants will have all they can do to supply the Canadian market. The period of depression had been the worst that Canada had ever experienced and now the outlook is perhaps better than it has ever been. He also considers the electrical outlook excellent.

MR. CLEMENT F. STREET has been appointed commercial engineer of the Westinghouse Electric & Manufacturing Company to handle work in connection with steam railroads. Mr. Street has had a wide experience in the railroad field gained through connection with many important interests and his selection by the Westinghouse Electric & Manufacturing Company is a high compliment to his ability as an engineer. Mr. Street's career began in the service of the Buckeye Engine Works, of Salem, Ohio, where he served six years, three years as an apprentice to the machine trade and three years in the drafting room. Leaving this company he became connected with the Johnston Co., of Johnstown, Pa., where he spent two years as chief draftsman. The next ten years were spent in the engineering department of the E. P. Allis Co. He resigned this position to assume one of greater responsibility with the Chicago, Milwaukee & St. Paul Railway. After four years of service with the latter company as chief draftsman in the motive power department, he entered the journalistic field as editor and manager of the *Railway Review*, of Chicago. While connected with the *Review* he spent the years '94 and '95 traveling around the world as engineer of the Commission World's Transportation of the Field Columbian Museum, of Chicago. Upon his return he made an exhaustive report to the commission upon the railroads of North Africa, Egypt, Ceylon, India, Burmah, Siam, Java, Australia and Japan. Upon retiring from this field, he became manager of the railway department of the Dayton Malleable Iron Company, of Dayton, Ohio. His latest field of activity has been with the Wellman-Seaver-Morgan Company, of Cleveland, Ohio, in the capacity of manager of its railway department, which position he has just resigned to accept this one of still greater responsibility with the Westinghouse Electric & Manufacturing Company. He is a member of the American Society of Mechanical Engineers, the Western Railway Club and the Railway Master Mechanics' Association.

Trade Notes.

REMOVAL.—The General Incandescent Arc Light Company has removed its Cleveland branch office to Cincinnati, Ohio, 62 Perin Building.

CRANE COMPANY, Chicago, has just issued a special catalogue, No. 100, devoted to its pop safety valves, water relief valves, boiler trimmings, and kindred specialties. It is a handsome, large octavo pamphlet of 94 pages, well illustrated.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY, New York, has closed the contract with Westerly, R. I., for its new street lighting system, which embraces a 50-light circuit. The contract, it is said, was secured in the face of very severe competition.

THE ELECTRIC APPLIANCE COMPANY, Chicago and San Francisco, is still advocating the contract method of buying lamps. The lamp season is now at its height and an unusually heavy fall business, the company says, is being handled with ease and promptness, owing to the large number of its customers taking advantage of the contract system.

THE COMPILING BUREAU, 56 Pine Street, New York, has issued a little pamphlet describing its work. The pamphlet contains a facsimile letter which is reproduced to show that the work of the Bureau is a time-saver and a money-saver, which means, of course, that the companies for whom the Compiling Bureau prepares matter are enabled to profit thereby.

PRESENT OF STORAGE BATTERY EXHIBIT.—It is reported that the Electrical Storage Battery Company, Philadelphia, has presented to the Worcester Polytechnic Institute, Worcester, Mass., the entire display made by the company at the exposition in St. Louis. At the close of the exposition the exhibit will be shipped to Worcester and installed at the Institute.

FORCED PUMP LUBRICATION.—The increase in mechanical efficiency of engines with forced lubrication has been clearly shown by recent engines built by the B. F. Sturtevant Company, at Hyde Park, Mass., and fitted with a forced pump lubricating system. An increase of from eight to ten per cent. is shown, and with its latest type of vertical single engines a mechanical efficiency averaging 94 per cent. is attained.

McMEEN & MILLER, 1442-1443 Monadnock Block, Chicago, have been retained as engineers for the new Quincy, Ill., independent telephone company, of which Mr. Charles Wheat is general manager. They will have entire charge as electrical engineers of the construction of the plant, and they have opened a branch office in Quincy, Ill. The work will be pushed with as much vigor as is consistent with giving proper results, and it is expected to have the new system in operation within a few months.

THE VIADUCT MANUFACTURING COMPANY, Baltimore, Md., is placing upon the market an entirely new telephone outfit designed for the use of those requiring a portable telephone for any purpose. It is designed to supersede the cumbrous wooden box outfit used for testing and is a serviceable telephone complete in a genuine leather case of small dimensions. It was designed originally for firemen to use in their rough work and always to have a telephone at hand in their pocket or wagon to connect with the fire alarm box, but it was also found to be a useful form of telephone for linemen, inspectors, trolley men and others.

THE EASTERN CARBON WORKS, of Jersey City, N. J., enjoy the confidence of a large majority of automobilists and launch owners, due to the uniform high-grade work of their famous dry batteries for gas engine ignition. Appreciating the support of the trade generally, they equipped their salesman with a motor carriage and from June to October he covered over 5000 miles, visiting even the smallest towns, with perhaps only one garage, but always with gratifying results as to sales. This concern has always been noted for its progressiveness and fills an important place in the electrical field as manufacturer of high grade wet and dry batteries, carbon brushes, carbon specialties, electric flash lights and other electric novelties.

THE AMERICAN ELECTRIC FUSE COMPANY was awarded first prize on its exhibit of protectors at the World's Fair, St. Louis. Its exhibit was a very handsome one, including protectors of all types for telephone exchanges. The company is very proud of its record in taking the first prize, and announces that its protectors were taken from its regular stock, and are, therefore, precisely the same protectors as are shipped by the company to its customers. Since October 1 the American Electric Fuse Company has received orders for over 10,000 pairs of Kaisling protectors, including two orders from abroad, and the company states that the inquiries received regarding it have averaged more than a dozen a day for the past month. Over 500 sample protectors have already been distributed, and requests have been received for as many more, which are being made up and sent out as rapidly as possible.

LUNCHEON TO AMERICAN STREET RAILWAY ASSOCIATION.—At the Thursday morning session, October 13, of the American Street Railway Convention at St. Louis, notice was given by the secretary that the Gould Storage Battery Company wished to invite all delegates and guests to take lunch at its booth immediately after adjourning that day. In response to this invitation, delegates from the three associations repaired to the booth of the Gould Company at Section 16, Electricity Building, and found prepared for them a very delightful lunch which was served in an informal manner. The booth was shut off from the rest of the building by draperies, and was very prettily lighted by ornamental fixtures. While the guests were enjoying their lunch, they inspected the various parts of the exhibit and were particularly interested in the working exhibit of booster-battery regulation. The affair was pronounced a decided success by those who were fortunate enough to be present, and the expressions of appreciation were many and varied.

WESTINGHOUSE AWARDS AT THE ST. LOUIS EXPOSITION.—The Westinghouse Companies have received the following awards by the International Jury at the St. Louis Exposition: A special award in the Department of Machinery for "the best, most complete, and most attractive installation." The companies have also received twelve grand prizes, distributed as follows: To the Westinghouse Electric & Manufacturing Company, three grand prizes in group 67, for "alternating-current generators and motors, alternating-current turbo-generator installation, static transformers, and rotary converters"; for "direct-current generators and motors," and for "electric railway motors, alternating current and direct current, and control systems for single and multiple unit operation and for mining and industrial locomotives." The Westinghouse Machine Company received one grand prize for "horizontal gas engines and steam turbines" in groups 62 and 63; the Westinghouse Air Brake Company, one for "air brakes and friction draft gears" in group 74; the Westinghouse Traction Brake Company, one for "brakes for electric cars" in group 74; the American Brake Company, one for "driver brakes" in group 74; the Westinghouse Automatic Air & Steam Coupler Company, one for "air and steam couplers" in group 74; the Westinghouse Brake Company, Limited, London, England, one for "air brakes and accessories" in group 74; the Union Switch & Signal Company, one for "signal system" in group 74; and the Cooper Hewitt Electric Company, one for "the development of the mercury vapor arc lamp" in group 69. In addition the companies received eight gold medals distributed as follows: Four to the Westinghouse Electric & Manufacturing Company, for "complete switchboards and controlling apparatus, and the application of electric motors for mechanical purposes" in group 67; for "alternating current, direct current, and Bremer arc lamps and arc lighting systems" in group 69; one for "industrial betterment work" in group 138 and one for "electric measuring instruments" in group 71; to the Nernst Lamp Company, one for "Nernst lamps" in group 69; to the Cooper Hewitt Electric Company, one for "vapor lamps for photo engraving" in group 15; to the Pittsburg Meter Company, one for "water and gas meters" in group 64, and to the Westinghouse Air Brake Company, one for "the housing of the working classes" in group 136. The companies also received four silver medals as follows: To the Westinghouse Electric & Manufacturing Company, one for "switches, fuses and wiring appliances" in group 69; to the Sawyer-Man Electric Company, one for "incandescent lamps" in group 69; to the Bryant Electric Company, one for "electric light fittings" in group 69; and to the Société Anonyme Westinghouse, Havre, France, one for "gasolene automobiles" in group 72. The Perkins Electric Switch Manufacturing Company also received a bronze medal for "electric switches" in group 69.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCT. 18, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

771,858. COMMUTATOR; John H. Brown, Reading, Pa. App. filed Jan. 7, 1904. The commutator plates are of uniform thickness and involute curvature, one resting directly upon or overlapping the next around the entire cylindrical surface, so that commutator segments without tapering cross-seciton can be used. (Issued Oct. 11.)

772,354. ELECTRIC FURNACE; Henri Harmet, St. Etienne, France. App. filed March 20, 1902. (See page 734.)

772,368. ELECTRICAL TIME CUT-OUT FOR CONTROLLING RAILWAY BARRIERS OR THE LIKE; Franz Neugebauer, Goldschmieden, Deutsch Lissa, Germany. App. filed May 26, 1904. Improvements in that class of time cut-outs for controlling railway barriers, in which cut-outs a two-chambered tilting vessel filled with mercury is employed for closing the working circuit.

772,380. METAL-SHEATHED ELECTRIC CABLE; Friedrich Schliefenbaum and Eugen Schürer, Mulheim-on-the-Rhine, Germany. App. filed Sept. 21, 1903.

772,396. QUADRUPLEX TELEGRAPHY; John C. Barclay, New York, N. Y. App. filed Feb. 1, 1904. Consists in means for connecting two generators of opposite polarity to the line alternately and in means for operating the vibrating connectors of a plurality of quadruplex lines from a common source.

772,400. ELECTRICAL MACHINE; Ole Sivert Bragstad and Jens Lassen La Cour, Karlsruhe, Germany. App. filed June 13, 1902.

772,401. PORTABLE LIGHT; George M. Brill, Philadelphia, Pa. App. filed April 29, 1903. Structural details of a mounting for a portable incandescent lamp.

772,415. BATTERY-HOLDER; Frank Jackson, Denver, Col. App. filed March 4, 1904. (See page 735.)

772,438. VIBRATOR; Charles F. Splitdorf, New York, N. Y. App. filed Jan. 23, 1904. Relates to circuit-breakers for induction-coils and pertains particularly to interrupter mechanism designed for use with the high-tension jump-spark coils employed in gas-engine apparatus.

772,456. ELECTRICAL CONDUCTOR FOR ELECTRIC RAILWAYS; Theophilus P. Chandler, Philadelphia, Pa. App. filed April 18, 1904. A two-part tubular coupling adapted to secure the threaded ends of two sections of an electrical conductor together.

772,459. COUNTER FOR REGISTERING CALLS FOR AUTOMATIC TELEPHONE EXCHANGES; John Erickson, Chicago, Ill. App. filed Nov. 15, 1902.

772,465. ALTERNATING CURRENT MOTOR; Waldo A. Laymon, St. Louis, Mo. App. filed March 9, 1903.

772,547. TROLLEY SWITCH FOR BLOCK SIGNAL SYSTEMS; Joseph Weatherby, Jr., New Cumberland, Pa. App. filed Dec. 7, 1903. Relates to switches for block-signal systems for electric railways, and particularly

to switches of that kind operated by the trolley of the car at a turnout station to close an electric circuit controlling the signaling mechanism.

772,548. SIGNAL MECHANISM; Joseph Weatherby, Jr., New Cumberland, Pa. App. filed Dec. 10, 1903. A device especially designed for use in connection with a system shown in a prior patent. The semaphore is electrically operated by a moving car to show whether or not the block is clear.

772,553. INSULATOR PIN; James H. Bullard, Springfield, Mass. App. filed Aug. 8, 1903. A pin of peculiar design in which compactness of form, strength and lightness are the principal features.

772,590. INDUCTION COIL; Richard Varley, Providence, R. I. App. filed July 12, 1904. A cover of thin rubber in the form of a cap, completely envelops the vibrator, the adjusting screws being accessible by compressing the flexible walls of the cover so that the screws may be grasped by the fingers through the cover.

772,591. INDUCTION COIL; Richard Varley, Providence, R. I. App. filed July 12, 1904. The invention consists of a box or housing having electrical contacts therein and an induction-coil adapted to fit within said box and provided with contacts or terminals which when the coil is in place are adapted to engage the contacts in said box.

772,592. INDUCTION COIL; Richard Varley, Providence, R: I. App. filed July 18, 1904. An auxiliary magnet included in the primary circuit of the induction coil causes an extra pressure to be brought to bear upon the main contacts at the moment the primary circuit is closed, thus reducing the resistance of the circuit. This effect is immediately succeeded by a counteracting influence which leaves the coil but little work to do to open the circuit.

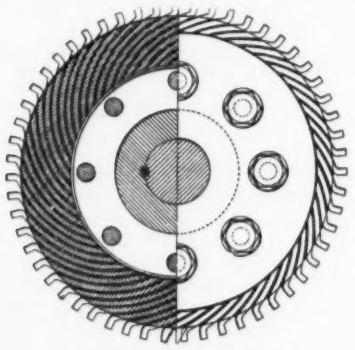
772,604. ELECTRIC INTERLOCKING SWITCH AND SIGNAL SYSTEM; Gustave Bleynie and Theophile Ducousso, Paris, France. App. filed April 29, 1904. Improvements on prior patent.

772,630. METHOD OF TRANSFORMING ELECTRICAL CURRENTS; Albert L. Parcelle, Boston, Mass. App. filed April 10, 1903.

772,638. TROLLEY HEAD FOR ELECTRIC TRAM CARS; Wilhelm Willenbucher, Manchester, England. App. filed Jan. 7, 1904. Relates to trolley heads for electric tram cars in which the grooved trolley wheel, together with a fork or the like which facilitates its emplacement on the conducting wire, is capable of swinging around a vertical pivot.

772,644. FIRE ALARM SYSTEM; William L. Denio, Rochester, N. Y. App. filed May 9, 1904. Provides means for giving an "answer back" signal. Also means for informing central office whether an alarm box was started by some accident or by being operated in the prescribed manner. Includes a telephone.

772,654. SAFETY DEVICE FOR VEHICLES OR OTHER APPARATUS; George H. Fraser, Brooklyn, N. Y. App. filed Jan. 22, 1900. Weight of



771,858.—Commutator.

driver on seat is utilized to retain parts in operative connection. When seat is unoccupied, driving mechanism is thrown out and brake applied.

772,658. ELECTRIC ARC LAMP; George F. Grove, Dayton, Ohio. App. filed Jan. 11, 1904. An arrangement by which the arc is at the lowermost point of the lamp and the whole lamp shortened up.

772,665. BLOCK SIGNAL; Charles H. Morse and Charles F. Hopewell, Cambridge, Mass. App. filed March 21, 1904. Relates to block signals of the type especially adapted for use as trolley signals for electric street railways. Improvements on former patent.

772,666. ROENTGEN TUBE; Carl H. F. Muller, Hamburg, Germany. App. filed Nov. 22, 1902. A vacuum-tube containing an anticathode and a plurality of cathode terminals, the cathodes being arranged so as to produce rays of different penetrative power.

772,667. X-RAY TUBE; Carl H. F. Muller, Hamburg, Germany. App. filed March 23, 1904. A vacuum-tube having anode and cathode rays and a secondary regulator for controlling the degree of vacuum of the tube.

772,717. APPARATUS FOR REMOVING WATER FROM PEAT; Bernhard Kittler, Memel, Germany. App. filed March 19, 1904. Provides means for agitating the peat and subjecting the same to electro-osmotic action and to heat.

772,734. GATHERING LOCOMOTIVE FOR MINE HAULAGE SYSTEMS; Edmund C. Morgan, Chicago, Ill. App. filed April 27, 1904. Provides means for paying out and taking up a current carrying cable to supply current to a locomotive working in a shaft of a mine at a distance from the main shaft, in which the trolley wire is located.

772,772. THERMO ELECTRIC FIRE ALARM; Herman Barditzky, Memphis, Tenn. App. filed May 14, 1904. Details.

772,773. COMBINED RECEIVER AND TRANSMITTER BRACKET FOR TELEPHONES; Harry A. Barnes and Nelson E. Showacre, Baltimore, Md. App. filed May 6, 1904.

772,782. SIGNALING DEVICE FOR TELEPHONE SYSTEMS; Henrik Thore Cedergren, Stockholm, Sweden. App. filed Jan. 28, 1902.

772,833. TELEPHONE EXCHANGE SYSTEM; Charles E. Scribner, Chicago, Ill. App. filed Oct. 21, 1899.

772,862. PROCESS OF ELECTRICALLY TREATING GASES; Kristian Birkeland, Christiana, Norway. App. filed June 15, 1903. (See page 734.)

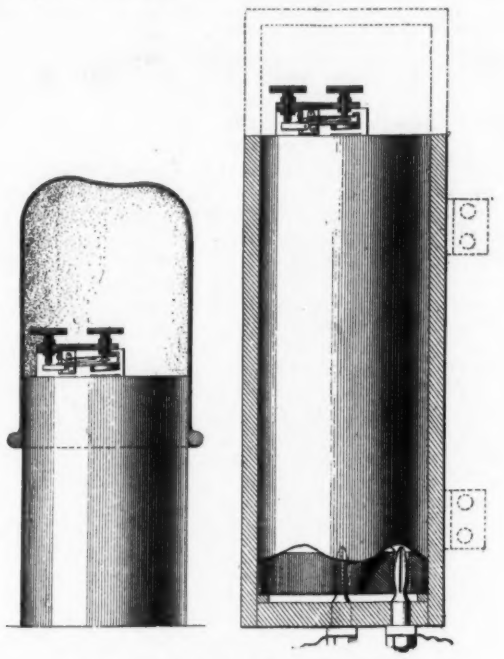
772,871. TELEPHDONE EXCHANGE TRUNK CIRCUIT APPARATUS; Charles A. Crapo, Denver, Col. App. filed Dec. 29, 1902.

772,872. CURRENT SAVING AND SPARK REDUCING DEVICE FOR ELECTROMAGNETS. App. filed Dec. 8, 1900. Provides means whereby an ordinary electromagnet may be so connected that when its armature moves, its connections are successively changed from multiple series and then to double series.

772,877. ELECTRIC LAMP; George F. Fischer, New York, N. Y. App. filed July 9, 1902. A medical lamp adapted to be worn on the head and capable of being moved in any desired direction without interfering with the electrical connections.

772,878. MAGNETIC DETECTOR; Lee De Forest, New York, N. Y. App. filed June 20, 1903. A magnetic detector comprising a magnetizable shell and a demagnetizing coil, both within and without said shell, one of said coils being adapted for connection with the antenna and the other with the ground.

772,879. ART OF DUPLEX WIRELESS TELEGRAPHY; Lee De Forest, New York, N. Y. App. filed June 4, 1903. The method of simultaneously



772,590 and 772,591.—Induction Coil.

transmitting and receiving a message at the same station which consists in employing different spark frequencies for the transmitting and the receiving waves, and in isolating the indicating device of the receiving apparatus from the effects of waves produced by the associated transmitter during the time of duration of each spark and in submitting the indicating device to such influences between each spark.

772,891. PROCESS OF REMOVING WATER FROM PEAT; Barnhard Kittler, Memel, Germany. App. filed June 17, 1904. A process for treating peat which consists in agitating the same and subjecting it to the simultaneous action of an electric current and a vacuum.

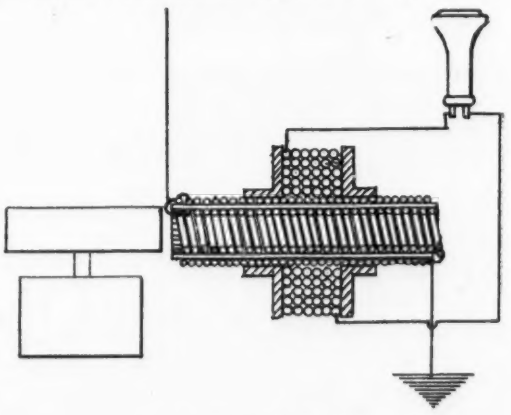
772,893. ATTACHMENT FOR TELEGRAPH KEYS; Daniel A. Lawrence, Weldon, N. C. App. filed Nov. 18, 1903. A device to support the hand of the operator in easy position.

772,896. APPARATUS FOR TELEPHONE SWITCHBOARDS; Frank R. McBerty, Evanston, Ill. App. filed Dec. 26, 1899.

772,897. BUSY SIGNAL FOR TELEPHONE TRUNK LINES; Frank R. McBerty, Evanston, Ill. App. filed Jan. 14, 1901.

772,898. TRUNK LINE FOR TELEPHONE EXCHANGES; Frank R. McBerty, Evanston, Ill. App. filed Jan. 26, 1901.

772,899. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; Frank R. McBerty, Evanston, Ill. App. filed Feb. 12, 1902.

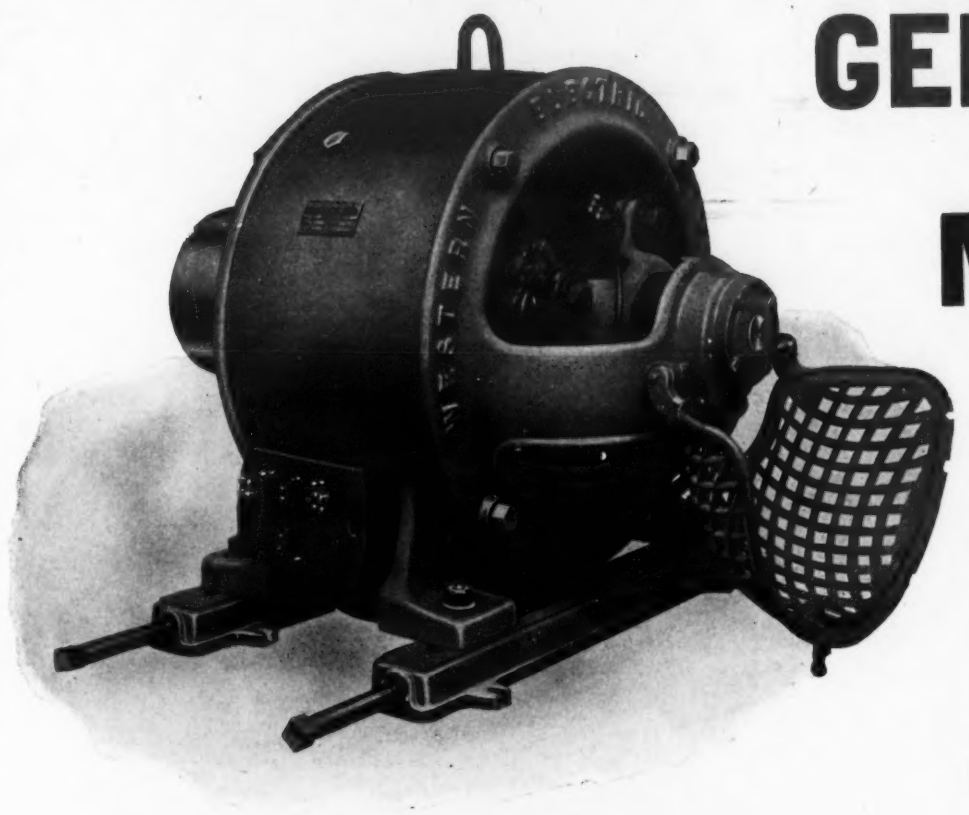


772,878.—Magnetic Detector.

772,900. TELEPHONE EXCHANGE SYSTEM; James L. McQuarrie, Chicago, Ill. App. filed Jan. 14, 1901.

772,908. FLASHING DEVICE FOR INCANDESCENT ELECTRIC LAMPS; Corneil Hidderhof and Greyson E. Miles, Grand Rapids, Mich. App. filed Dec. 9, 1903. Details.

12,276. AUTOMATIC TRAIN STOP; Louis H. Thullen, Edgewood, Pa. App. filed Sept. 23, 1904. A stop or trip is so located beside the track that it may engage an arm carried by the train and controlling valve or braking mechanisms. The stop or trip may be moved out of operative position by a rod connected with a semaphore signal and held in such position by what is known as an "electric slot mechanism."



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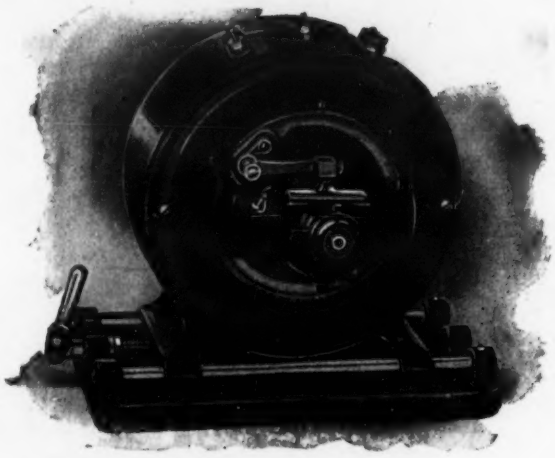

SPECIFICATIONS

For the entire line:

Number of frames, 15.
Voltages, 20 to 650.
Brake Horse-power, 1-30 to 15.
K.W., 1-2 to 10.
Speed range, universal.
With or without sliding base.
Idlers when required.
Back-geared motors, any reduction.
Open.
Protected.
Gauze enclosures.
Half enclosures.
Solid, dust-proof enclosures.
Variable speed
Mounting, floor, side wall or ceiling.
Reversible rotation.
Laminated pole pieces, frames 3-4 to 12 1-2.
Ventilated armatures, forced draft, frames 1 to 12 1-2.
Hard-drawn copper commutators.
Form-wound coils.
Standard windings in stock.
Special windings on short notice.

The Robbins & Myers Co.,

Main Office and Works, Springfield, O.

New York Office, 170 Broadway.

If Watson Motors were built just to sell they might be built cheaper and for a while more might be sold.
Instead they are built to

Do the Work.

Their economy does not begin and end with their purchase. It lasts as long as they are in operation.

It is not in low first cost but in efficiency, durability, economy in operation and lack of necessity for repairs. They earn a dividend every day.

THE
WATSON MOTOR

Stands for the best in material and workmanship that money can buy.

Built for either gear or belt connection.

THE MECHANICAL APPLIANCE CO.
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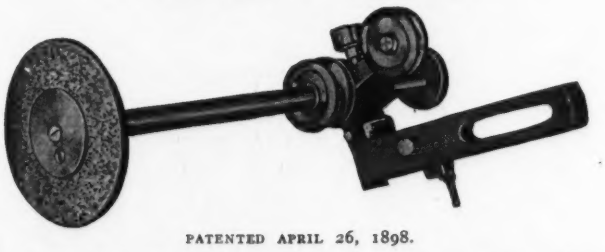
THE JORDAN COMMUTATOR TURNING DEVICE



PATENTED APRIL 26, 1898.

This wheel is made of a special composition for turning copper, and contains no emery or other mineral matters which would be injurious to the commutator.
Can be applied to any ordinary dynamo or motor for turning commutator, thereby saving the labor, expense and delay of removing armature and placing in lathe in order to turn commutator.
When at the World's Fair, St. Louis, visit the Wesco Supply Co.'s booth, Electricity Building, and see this device in operation.

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JORDAN BROS.

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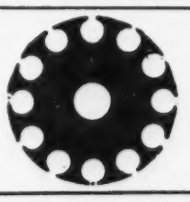

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